Vol. XXIV.—No. 158] [September, 1937

THE

MINERALOGICAL MAGAZINE

AND

Journal of

The Mineralogical Society

(*INSTITUTED FEBRUARY 3, 1876.*)

WITH A SEPARATELY-PAGED APPENDIX OF

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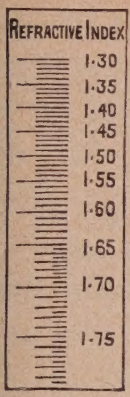

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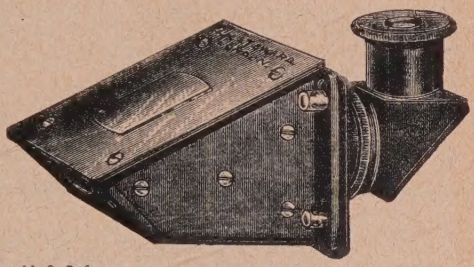

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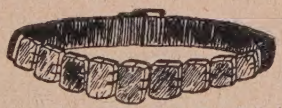

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THE MINERALOGICAL MAGAZINE
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No. 158 September, 1937 Vol. XXIV

Magnesium-zinc-spinels from Ceylon.

By B. W. Anderson, B.Sc., F.C.S., and C. J. Payne, B.Sc.
Laboratory of the Diamond, Pearl, and Precious Stone Trade Section of the London Chamber of Commerce.

With a chemical analysis by M. H. Hey, M.A., D.Sc.
Mineral Department, British Museum.

[Read November 14, 1935.]

ALTHOUGH the mineral spinel belongs to an isomorphous group, and in the simple formula $MgO.Al_2O_3$ both Mg and Al are susceptible to isomorphous replacement, yet in the transparent varieties of gem quality there is, as a rule, very little deviation from the type composition, and the physical properties are moderately constant. In fact, one may say that the only considerable replacement hitherto recorded in spinels used as gemstones is by ferrous iron in the variety known as ceylonite or pleonaste, which is black and opaque even when 7 or 8 % of FeO is present, the end-member of this series being hercynite, $FeO.Al_2O_3$, with 41 % ferrous oxide.

The purpose of this paper is to draw attention to certain transparent blue spinels from the gem gravels of Ceylon, the physical properties of which differ quite strikingly from those of the normal spinels, from which they are indistinguishable in appearance, magnesium being replaced in this instance not by ferrous iron but by zinc.

Before describing in detail the specimens of this magnesium-zinc series it will be advisable to consider the physical properties of magnesium-spinel, $MgO.Al_2O_3$, as the data in the literature are not entirely satisfactory. For instance, Rinne,[1] in his elaborate paper

[1] F. Rinne, Neues Jahrb Min., Abt. A, 1928, Beil.-Bd. 58, p. 43. [Min. Abstr., 4–71.]

on artificial spinel, gives d 3·577 and n_D 1·7182 for the pure com pound, while the following data for natural spinel are not consistent with these figures. Except for the first line, those in table I hav been determined by the authors at various times.

TABLE I. Data for ordinary gem spinels.

Colour.	Locality.	Carats.	d.	n_D.	Dispersion (6708–4227 Å
Crimson	India	49⅞	3·582	1·714	—[1]
Pale mauve	Burma	5·561	3·586	1·7150	0·0205
,, ,,	?	2·275	3·588	1·7152	—
Pale blue	Ceylon	—	3·584	1·7153	0·0207
Lavender	,,	3·380	3·594	1·7164	0·0206
Fine blue	,,	12·208	3·611	1·7177	0·0209
Deep indigo	,,	3·720	3·605	1·7188	0·0212

Des Cloizeaux[2] gives n_D 1·7155 for red spinel; Zimányi[3] 1·71(for red spinel from Ceylon; Melczer[4] 1·7188 for blue spinel fro Ceylon; Bauer[5] 1·7201 for blue, almost black, spinel. Schlossmache states that red, blue, brown, and violet stones from Ceylon ha n_D 1·715–1·722. Church's individual values for densities range fro 3·582 for red stones to 3·675 and 3·715 for indigo stones. Braun states that native spinels of all colours have densities between 3· and 3·62.

It would seem from the above data that pure magnesium-spinel h n_D 1·715, d 3·58, this density agreeing exactly with the theoretical de sity based on X-ray measurements.[8] The usual impurities, Fe, Mn, Z Cr, Ti, increase the values both for density and refractive inde The figures given may therefore be taken as the lower limits natural spinel.

One or two blue spinels examined in the course of routine wo had densities which seemed remarkably high, but it was not unti stone was encountered which was found to have d 3·947 and n_D 1·74 that it became clear that there exists a variety of spinel that is qu

[1] A. H. Church, Precious Stones, London, 1905 edition, p. 68; 1924 editi p. 85.

[2] A. Des Cloizeaux, Nouvelles recherches . . ., Mém. Acad. Sci. Paris, 18 vol. 18, p. 203.

[3] K. Zimányi, Zeits. Kryst. Min., 1894, vol. 22, p. 328.

[4] G. Melczer, Zeits. Kryst. Min., 1900, vol. 33, p. 260.

[5] M. Bauer, Neues Jahrb. Min., 1895, vol. i, p. 281.

[6] K. Schlossmacher, Zeits. Krist., 1930, vol. 72, p. 468. [Min. Abstr., 4–2

[7] R. Brauns, Deutsche Goldschmiede-Zeitung, 1929, vol. 32, p. 458.

[8] S. Holgersson, Lunds Univ. Årsskrift, 1927, N.F. Avd. 2, vol. 23, no. 9.

distinct from any which has previously been recorded. The fact that the absorption spectrum of this specimen was found to be identical with that of normal blue spinel was, however, accounted sufficient evidence that no entirely new species was involved.

A diligent search amongst parcels of blue spinels from Ceylon, both as cut stones and rough water-worn pebbles, resulted in the separation of a number of specimens of this type; the densities and refractive indices graded from 3·981 and 1·7469 down to the values for normal magnesium-spinel. For convenience of reference the data for the full range of these specimens are collected in table II. All these stones are transparent.

TABLE II. Data for magnesium-zinc-spinels.

No.	Colour.	Density.*	n_D.†	Dispersion (6708–4227 Å.).‡	Remarks.
1.	Blue	3·981	1·7469	0·0233	—
2.	Pale blue ...	3·967	1·7465	0·0229	Analysis (p. 551)
3.	Pale lavender ...	3·947	1·7432	0·0226	4·55 cts.
4.	Dark blue-green	3·934	1·746	—	Iron rich
5.	Pale blue ...	3·904	—	—	Rough pebble
6.	Blue	3·897	1·740	—	—
7.	Sapphire-blue ...	3·885	1·739	—	—
8.	Pale lavender ...	3·883	1·7362	0·0222	Spectrum analysis
9.	,, ,, ...	3·797	1·7308	0·0218	—
10.	Indigo	3·740	1·730	—	Half of water-worn octahedron
11.	Deep indigo ...	3·733	1·7293	0·0219	—
12.	Indigo	3·712	1·7282	0·0219	—
13.	,, ...	3·690	1·7252	—	Spectrum analysis
14.	,, ...	3·635	1·7235	—	—
15.	,, ...	3·631	1·7213	0·0213	—
16.	Lavender ...	3·627	1·7196	0·0211	Spectrum analysis
17.	Deep blue-green	3·625	1·7213	—	—
18.	Pale blue ...	3·613	1·7184	0·0211	Spectrum analysis
19.	Pale indigo ...	3·606	1·7182	0·0210	—
20.	Deep ,, ...	3·605	1·7188	0·0212	Normal iron-rich type
21.	Lavender ...	3·594	1·7164	0·0206	Spectrum analysis
22.	Pale blue ...	3·584	1·7153	0·0207	—

* No. 3, ±0·001; other determinations ±0·003.
† No. 2, ±0·0001; nos. 4–7, ±0·001; other determinations ±0·0002 or 0·0003.
‡ All ±0·0001.

Unfortunately the specimens were not very large, the largest, no. 3, being 4·55 carats. This necessitated a special technique[1] for density

[1] H. E. Vassar, Amer. Min., 1925, vol. 10, p. 123. [M.A. 2–487.]
C. J. Payne, L. Franklin, and B. W. Anderson, Gemmologist, 1936, vol. 5, p. 274. [M.A. 6–454.]

determination by utilizing Clerici solution (thallium malonate an formate in aqueous solution), which can be readily adjusted to an given density from 4·2 downwards by dilution or concentration, th refractive index of the solution varying directly with the densit If the refractive index be measured to $\pm 0{\cdot}0001$, the density of th solution may be estimated to $\pm 0{\cdot}001$, or $\pm 0{\cdot}003$ allowing f experimental error.

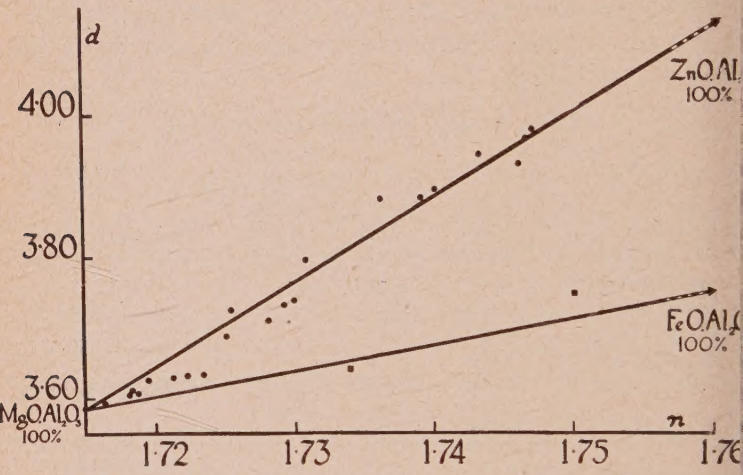

FIG. 1. Graph plotting densities and refractive indices of magnesium-zinc-spinels (round dots) and pleonastes (square dots).

The refractive indices of all specimens were measured gon metrically by the prism method, except nos. 7 and 10. The disp sions were measured from Li 6708 to Ca 4227 Å., the calcium li being chosen since, in conjunction with the lithium line, it gives range corresponding roughly to that given by the solar B–G lines, a at the same time is intense, persistent, and distinctive; the shor range, C–F (hydrogen), does not reveal such slight variation in d persion as is shown by these specimens. Furthermore, both th lines, together with K 7699, Tl 5350, and Ca 3934 (K), can be read introduced into a carbon arc. It can be seen that the dispersi vary with the refractive indices from 0·0206 to 0·0233.

It may be noted that there are slight inconsistencies in the p perties shown in table II. None of the specimens from this sou is quite free from iron; many—as the colour descriptions indicat

contain an amount of FeO quite sufficient to influence the properties. The presence of FeO causes a greater increase in refractive index relative to density than in the case of ZnO.

In fig. 1 the data given in tables I and II for n_D and d are presented graphically. It was found that when the theoretical data for the zinc-spinel, gahnite, d 4·625, n_D 1·805,[1] were plotted on this graph, the specimens under consideration occupied positions approximating very closely to a straight line drawn between the two end-members of the gahnite-spinel series. Since it could not be supposed that the replacing oxide had any influence on the colour, it seemed very probable that the variations were due to the presence of ZnO, and the higher members of the series were, in fact, gahnite-spinels. The graph also shows a few pleonastes, which are seen to lie near a line connecting spinel to hercynite. Other replacement possibilities, considered in similar fashion, depart even farther from the steep slope leading to gahnite.

To confirm the hypothesis that the unusual properties of these spinels were due to the replacement of MgO by ZnO, a spectrographic analysis was taken of no. 8, a pale lavender stone. This was found to show strong development of the zinc lines, leaving no doubt as to the presence of a considerable quantity of this element. Traces of iron also were present, and there were traces of Mn, K, and Cu. The complete absence of all other elements, including Co, Si, Ca, Na, Cr, was noteworthy. It seems reasonable to suppose, therefore, that the colour in this specimen may be ascribed mainly to ferrous iron, possibly modified by manganese or copper.

Dr. M. H. Hey kindly undertook a quantitative micro-analysis of no. 2, a pale blue rolled pebble, in appearance indistinguishable from the normal Ceylon type. The results of the duplicate micro-analyses are as follows:

	I.	II.	Mean.	Mol. ratios.	
Al_2O_3 ...	63·37	63·05	63·21	0·6201	
FeO ...	1·93	1·93	1·93	0·0269	0·6669
MgO ...	16·88	16·67	16·78	0·4162	
ZnO ...	18·20	18·23	18·21	0·2238	
	100·38	99·88	100·13		

[1] Based on V. M. Goldschmidt's X-ray measurements of the cell side for $MnO.Al_2O_3$, 8·062, and $MgO.Al_2O_3$, 8·059 Å. (Zeits. Physikal. Chem., Abt. B, 1932, Bd. 18, p. 29), and taking the density of $MgO.Al_2O_3$ as 3·585. Refractive index as quoted by E. S. Larsen for artificial gahnite (Microscopic determination of the nonopaque minerals, Bull. U.S. Geol. Surv., 1934, no. 848, p. 58).

The iron was assumed to be in the form of FeO.[1] The analytic method used was chosen after two other possible methods had prov unsatisfactory on the micro-scale, and was as follows: 10 mg. spir were fused with 0·15 g. $K_2S_2O_7$, dissolved, and precipitated wi 8-hydroxyquinoline in alkaline tartrate solution (about N/5 NaOH The precipitate of Zn and Mg 8-hydroxyquinolates was filtered c dried, and weighed; while the filtrate was neutralized with HCl, a iron and aluminium precipitated as 8-hydroxyquinolates in ammon cal solution, filtered off, dried, and weighed. The Zn and M 8-hydroxyquinolates were dissolved in dilute HCl, diluted, and exc sodium acetate added so as to give a final concentration of 5 % sodiu acetate and 1–2 % acetic acid; the precipitate of zinc 8-hydrox quinolate was filtered off, dried, and weighed. The weighed hydroxyquinolates of iron and aluminium were dissolved in nit acid, the 8-hydroxyquinoline oxidized by repeated evaporation w nitric acid and hydrogen peroxide, and iron determined colorimet cally with thioglycollic acid and ammonia. The iron determinati was common to both analyses. A spectrographic analysis did r reveal the presence of any element other than those estimat above.

A calculation based on the physical data suggested that 15 % ZnO and 18·3 % of MgO would be present, together with 0·5 % FeO, estimate which is reasonably consistent with the percentages actua found.

With the knowledge that this specimen was destined for analy a 64° 7′ prism was cut and refractive indices were carefully measu for a large number of wave-lengths. The details, together with so measurements carried out on nos. 8, 9, 16, 18, 19, and 21, are gi in table III.

Ultra-violet spectrograms were also prepared from fragments nos. 13, 16, 18, and 21 in order to establish whether zinc was present in all blue Ceylon spinels; in all cases, except no. 17, defi evidence of this element was found. Iron was present in all spectra, and there can be no doubt that this element is the cause the colour, since Cr, Co, and Mn were absent. A trace of Ti was fo in no. 13.

A few notes as to the absorption spectrum of blue spinel may haps be given here, as it is sufficiently characteristic to form a us

[1] K. Schlossmacher and I. Meyer, Zeits. Krist., 1931, vol. 76, p. 377. [M 6–265.]

diagnostic test. Wherry[1] recorded two strong bands centred at 5500 and 4600 Å., with weaker bands at 5900 and 5100. He suggested Co as the cause of all these bands, except 5100, which he ascribed to Ti.

TABLE III. Refractive indices (±0·0003) of magnesium-zinc-spinels for various wave-lengths.

λ.	No. 2.	No. 8.	No. 9.	No. 16.	No. 18.	No. 19.	No. 21.
7685 Å. ...	1·738	—	—	—	—	—	1·7088
6925 ...	1·7412	—	—	—	—	—	1·7112
6708 ...	1·7421	1·7318	1·7266	1·7154	1·7140	1·7139	1·7122
6497 ...	1·7431	1·7329	—	—	—	—	1·7133
6141 ...	1·7448	1·7349	—	—	—	—	1·7151
5893 ...	1·7465	1·7362	1·7308	1·7196	1·7184	1·7182	1·7164
5536 ...	1·7492	—	—	—	—	—	1·7188
5350 ...	1·7506	1·7402	1·7346	1·7236	1·7222	1·7218	1·7200
5218 ...	1·7517	1·7415	—	—	—	—	1·7213
5106 ...	1·7527	1·7423	—	—	—	—	1·7221
4934 ...	1·7547	1·7441	—	—	—	—	1·7240
4603 ...	1·7587	1·7486	—	—	—	—	1·7283
4227 ...	1·7650	1·7540	1·7484	1·7365	1·7351	1·7349	1·7328
4063 ...	1·7677	—	—	—	—	—	1·7360
4023 ...	1·7686	—	—	—	—	—	—
3933 ...	1·7706	1·7593	1·7537	—	1·7407	—	1·7383
3883 ...	1·7719	—	—	—	—	—	1·7394
Prism angle	64° 7′	51° 46′	49° 57′	62° 45¾′	63° 59¼′	63° 7¼′	62° 2½′
Density ...	3·967	3·883	3·797	3·627	3·613	3·606	3·594

The authors' measurements on a very fine blue stone weighing 12·208 carats (see table I), using a Beck wave-length spectrometer, gave the following bands.

6320 Å. (approx.) ...	broad moderate
5920	weak vague
5770	,, ,,
5570	mod. weak narrow
5520	,, ,, ,,
5080	very weak narrow
4800	mod. strong narrow
4590	strong broad
4430	very weak narrow
4330	,, ,, ,,

Several of these bands cannot be observed in less richly coloured specimens, but the characteristic band at 4590 is invariably present even in pale stones, and is usually accompanied by the weaker bands at 5920, 5570, and 5520 Å.

[1] E. T. Wherry, Amer. Min., 1929, vol. 14, p. 326. [M.A. 4–209.]

In contrast to this spectrum, artificial blue spinel known to b coloured with cobalt has bands at 6330 (broad, strong), 5800 (broad strong), 5440 (moderate, broad), 4820 (weak), 4490 (moderate, broad) 4230 (narrow, strong).

The above data, taken in conjunction with the complete absenc of cobalt in all spectrum analyses undertaken, provide strong evidenc that the colour and absorption bands are due not to cobalt but t ferrous iron. Schlossmacher (loc. cit.) also arrived at this conclusio from chemical analyses and a study of the absorption curves.

The hardness of the zinc-rich types is $7\frac{3}{4}$–8, as with the norma spinel. Anomalous pleochroism occurred in a few of the specimen

While the authors have no wish to burden the literature wit unnecessary names, it may be reasonably claimed that many of th specimens described depart so widely in properties and compositio from the normal magnesium-spinel as to form a distinct sub-variet more distinct, for instance, than the iron-rich 'chlorospinel'. Sinc 'spinel' is the group name, 'zinc-spinel' would be held merely t denote gahnite. 'Gahnospinel' is tentatively suggested.

It may be wondered why members of this sub-variety have n previously been recorded. The explanation seems to lie in their com parative rarity. Out of over 300 specimens of blue spinel from parce of mixed Ceylon stones only four were found with densities great than 3·85. Types with lower percentages of zinc are more commo and, in fact, it seems that zinc is rarely altogether absent from bl Ceylon spinels.

In conclusion, we should like to express our sincere thanks Mr. Charles Mathews, not only for his kindness and skill in polishi specimens for the optical work, but also for presenting several of t stones examined; to Dr. J. Phemister for his assistance in checki the refractive indices of some of the specimens; to Mr. T. W. Oliv for kindly presenting stone no. 3; to Messrs. E. Hahn & Sons for t loan of large parcels of Ceylon stones; to Mr. L. Willis for the dra ing of the accompanying text-figure; and to the Diamond, Pearl, a Precious Stone Trade Section of the London Chamber of Commer in whose laboratory the investigation was carried out. Finally, have to thank Dr. M. H. Hey, without whose skilful analysis this pa would have been incomplete.

The paragenesis of kyanite-amphibolites.

(With Plate XX.)

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[Read June 24, 1937.]

IN an earlier paper [1] the writer has discussed the paragenesis kyanite-omphacite as observed in certain eclogites. The fate of this association under conditions of retrograde metamorphism has led to a consideration of rocks showing the paragenesis amphibole-kyanite, a point which is briefly taken up in the present communication. Rocks containing this latter assemblage include two groups, the one better known, of sedimentary origin, the other essentially igneous in origin.

(*a*) *Para-rocks.*

Here are included members of the para-amphibolites, biotite-hornblende-schists, and hornblende-*Garbenschiefer* derived from sediments of the character of calcareous and dolomitic shales. The best-known examples come from the Alps—particularly the Triassic and pre-Triassic sediments on the south side of the St. Gotthard massif.

Kyanite in these rocks may appear as an essential or accessory constituent and is found often in juxtaposition with the large porphyroblasts of hornblende which characterize the *Garbenschiefer*. Reference may be made to rocks of this type from the *Quartenschiefer* of the Lukmanier region [2], and some members of the pre-Triassic Tremola series are described by Hezner [3] as containing kyanite. The *Garbenschiefer* of the Tremola series, though they have suffered a soda metasomatism under the influence of Hercynian granitic intrusions, acquired their present crystalloblastic development under the influence of the Alpine folding.

Under the names para-amphibole-gneiss and para-amphibolite Rosenbusch [4] has described felspar-rich rocks from the Schwarzwald containing kyanite with kelyphitic rings of spinel with shells of

bytownite and labradorite. These rocks are recognized as metamorphosed calcareous sediments, but the amphibole content of the members containing kyanite is so low that the rocks scarcely come within the scope of the present discussion (cf. also Erdmannsdörffer's revised descriptions [5]). Rocks with the assemblage hornblende kyanite might be expected in the Dalradian Ben Lawers schist within the kyanite zone, but such assemblages have not so far been recorded from these or related Scottish rocks.

(*b*) *Kyanite-amphibolites of igneous origin.*

The literature contains little reference to kyanite-amphibolites of igneous origin. Kyanite-eclogites in process of amphibolitization would be expected to develop in an intermediate stage as kyanite-bearing amphibolized eclogites, but there is little note of such rocks in descriptions of transformed eclogites. In fact, the fate of kyanite in such eclogites deserves closer study than has been given to it.

Brière [6], in discussing the eclogites of France, refers briefly to the transformation kyanite undergoes in the process of development of garnet-amphibolite. She notes that kyanite is sheathed by a kelyphite of fine fibres of indeterminate character, which, however, appears to be heterogeneous, and believes that a part of this kelyphite is made up of basic plagioclase. The ultimate transformation of a kyanite-eclogite into a garnet-amphibolite of similar bulk composition is described in the case of an eclogite from Puy Ferrières, France [6, p. 127].

Patton [7] describes an eclogite from Einsiedl, north of Marienbad, Bohemia, in which the kyanite is associated with hornblende forming a kelyphitic shell around garnet. He notes, however, that the kyanite does not occur in intimate association with the omphacite of the eclogite. Ippen [8] records kyanite-amphibolites in an eclogite region at Oplotnitz in the Bachergebirge, Yugoslavia, but no detailed reference is made to their field associations. In discussing a garnet-amphibolite of igneous origin from the island of Shikoku, Suzuki [9] mentions a type rich in kyanite associated with it. These examples are mentioned to indicate the paucity of data that are available on the paragenesis under discussion.

Brière's analyses make it clear that the ultimate fate of some kyanite-eclogites is their conversion to kyanite-free amphibolites, and it is apparent that the disappearance of kyanite is accompanied

the entry of an aluminous mineral which may, according to conditions, be anorthite (in plagioclase), zoisite, or clinozoisite. Thus, where there is no change in bulk composition, the normal type of kyanite-eclogites would be expected to give place eventually to amphibolites in which kyanite has disappeared in the manner indicated. This follows from my previous discussion of the composition of kyanite-eclogites and the knowledge of the range of composition of amphibolite hornblendes (text-fig. 3).

Brief mention of a kyanite-amphibole paragenesis has been made by Clough in the Glenelg Memoir (Geol. Surv. Scotland, 1-inch Sheet 71) in the section devoted to the eclogites of the Glenelg region [10, p. 35]. There is noted the occurrence of a garnetiferous hornblende-schist with kyanite near an exposure of an eclogite ½ mile north of the Ordnance Station on Beinn a Chapuill. Clough also mentions that 'a mineral which resembles kyanite occurs in smaller quantity in the massive rock [eclogite] also'. Alderman [11], who recently discussed in detail the eclogites of the Glenelg area, analysed an amphibolized eclogite and an amphibole from a garnet-amphibolite from the actual exposure referred to by Clough. His material contained, however, no kyanite. The writer has since that time collected a suite of rocks from this locality and obtained an interesting group of kyanite-bearing amphibolites which come now for description.

Clough's exposure is an eclogite mass enclosed in the Lewisian gneiss. The massive eclogite is largely transformed and is represented by lenticles and bands of the unaltered rock surrounded by its amphibolized products. These hornblendic derivatives show a range of composition varying from amphibolized eclogite to hornblende-schist. Attention here is directed to the eclogite itself, the amphibolized eclogite, and the garnet-amphibolite which in places carries kyanite as Clough first recognized.

The unaltered eclogite is a medium-grained rock composed essentially of omphacite, garnet, and accessory rutile. The grain-size of both constituents averages 1–2 mm., but the garnet occurs also as larger grains up to 10 mm. in diameter. The garnet of this rock has been analysed by Pollard [10, p. 34] and corresponds to $Ca_{19.3}Fe_{37.4}Mn_{1.5}Mg_{41.8}$. Incipient amphibolization is developed even in the least-altered specimens, the amphibole first appearing at the contact of the garnet and omphacite.

The derived amphibolized eclogite analysed by Alderman is composed of hornblende, omphacite, and epidote, with residua of garnet,

and also contains accessory plagioclase and rutile. The garne
amphibolite stage, where plagioclase is more abundant, is recorde
by Alderman, who has analysed the predominant hornblende of o
of these rocks.

Now, some of these eclogite bands and lenticles are traversed b
white streaks built up essentially of acid plagioclase with min
quartz but containing characteristically small prisms of kyanit
These streaks may appear as thin threads isolated in the rock
packed closely together in a subparallel arrangement. They ha
developed during a period when the eclogite was subject to deform
tion and have all the appearance of arising as a result of shearing
high temperature accompanied by introduction of material (pl. x
fig. 1). The kyanite belongs only to these streaks and does n
appear in the omphacite-garnet assemblage, i.e. kyanite is not
original feature of the eclogite, but has developed at a later da
The effects of stress are often revealed in the garnets by the presen
of a parallel system of fractures which may be alined (*a*) parallel
the streaks, or (*b*) to narrow zones of amphibolization of the ro
which are sometimes of earlier date than the streaks.[1]

The streaks as mentioned above are composed of albite, olig
clase ± quartz, forming a fine granular growth with occasiona
larger oligoclase crystals showing vermiform inclusions of quar
Kyanite is interspersed in this aggregate in the form of prisms rang
in length from 0·1 to 0·5 mm. Scattered brown biotite flakes m
be present, and there are clots of green granular hornblende af
pyroxene. In one eclogite sliced the streaks show predomina
plagioclase with some quartz, and contain kyanite together w
clinozoisite. It is clear from the relations of these two miner
that kyanite may eventually disappear and its place be taken
clinozoisite. The kyanite becomes mantled by the epidote and
often relegated to a minute core.

To pass now to the rocks in immediate association with the ec

[1] Hezner (Tschermak's Min. Petr. Mitt., 1903, vol. 22, p. 463) reports kyan
as occurring only in a brecciated variety of eclogite forming blocks in
Schutthalde at Burgstein, Oetztal—the kyanite developing as light blue ve
penetrating the sections. In a slice collection of eclogites from this reg
I find, however, that kyanite is by no means limited to this type of associat
The available slides from Burgstein, Sulztal, and Sölden show kyanite in
spersed with omphacite and garnet as in the normal type of kyanite-eclog
The rock from Sölden is an amphibolized eclogite in which the kyanite is giv
place to clinozoisite via a minutely crystalline kelyphite similar to that descri
by Brière from the eclogite of St. Philbert de Grandlieu [6, p. 139].

gite. They comprise, as already noted, amphibolized eclogites, garnet-amphibolites, and hornblende-schists. That these rocks are ultimately derived from the eclogite seems clear. The garnets of these amphibolites are of the same type as those of the eclogites as indicated by their identical refraction, and residual pyroxene can be found enclosed within the garnets when omphacite has disappeared from the body of the rock. The garnet-amphibolites contain plagioclase or epidote, or both, and scapolite is often a minor constituent. Some of these types contain significant amounts of kyanite. It is these types that come now for description.

Some of the rocks contain only scattered garnets, but others represent coarse-grained types very rich in garnet. The constituents include, in addition to garnet, green hornblende, kyanite, andesine (zoned), both α- and β-zoisite, some scapolite confined often to definite bands, and rutile. Plagioclase varies much in amount and shows usually strong inverse zoning, oligoclase in the core with an andesine forming a shell. The extent of the zoning is, however, very variable. The scapolite is a dipyre ($Ma_{50}Me_{50}$).

In hand-specimens kyanite is by no means conspicuous, but careful scrutiny with a lens reveals white to very pale bluish streaks traversing the rock. These on microscopic examination are seen to be built essentially of kyanite. Examination shows that the kyanite occurs in the following associations:

1. In narrow streaks or clots elongated parallel to the foliation—the kyanite building subidioblastic prisms elongated parallel to the c-axis, and forming often the only mineral of the streak, which may be followed through the slice for six or more millimetres, though the width is usually under $\frac{1}{2}$ mm. The streaks are packed between a foliated aggregate of green hornblende which contains, especially near the streaks themselves, sparing little inclusions of kyanite (pl. xx, fig. 2).

2. As isolated crystals in a plagioclase-hornblende ground.

3. Associated with garnet. This is a less common association, but the occurrences are significant.

The garnets in these rocks are characteristically xenoblastic, and are clearly residual and in process of conversion to hornblende as chief degradation product. Some of the larger garnets of these rocks are traversed by narrow veins of hornblende containing minute prisms of kyanite, while other garnets in process of destruction appear to have place to hornblende together with larger crystals of kyanite

both types of associations presenting a picture of the transformation that the garnets of these rocks may undergo (text-fig. 2 and pl. xx figs. 3 and 5).

To throw further light upon the problems presented by these rocks analyses have been made of the least-altered type of eclogite in which only incipient amphibole development is present, the rock being

TABLE I.

	1.	2.	3.	4.	5.
SiO_2	48·74	45·66	45·23	47·50	47·00
TiO_2	0·86	1·13	0·59	1·03	1·00
Al_2O_3 ...	15·41	14·09	24·76	17·14	17·61
Fe_2O_3 ...	1·81	2·65	1·87	2·00	2·25
FeO... ...	8·81	10·87	7·64	6·04	6·78
MnO	0·15	0·17	0·09	—	—
MgO	10·71	11·23	7·67	10·37	8·78
CaO	10·68	12·18	9·18	13·61	14·90
Na_2O... ...	2·06	1·24	2·27	1·42	1·14
K_2O	0·35	nil	0·83	0·23	0·21
H_2O+ ...	0·41	0·34	0·24	0·19	0·40
H_2O- ...	0·13	0·04	0·09	0·02	
P_2O_5 ...	—	—	—	0·14	0·40
CO_2	—	0·19	—	—	—
	100·12	99·79	100·46	99·69	100·47
Sp. gr. ...	3·26	—	3·10	3·36	3·01

1. Eclogite, ½ mile slightly E. of N. of Ordnance Station, Beinn a Chapui Glenelg. Analyst, H. C. G. Vincent.
2. Amphibolized eclogite, same locality. Analyst, A. R. Alderman [11, p. 507
3. Kyanite-garnet-amphibolite, same locality. Analyst, H. C. G. Vincent.
4. Kyanite-eclogite, Puy Ferrières, France. Brière [6, p. 168].
5. Garnet-amphibolite, same locality. Brière [6, p. 127].

essentially composed of omphacite, garnet, and rutile, with accesso amphibole derived in the manner already indicated (analysis table I). This rock is identical with the specimen collected b Clough from this locality (Geol. Survey slice 8449), and from whic presumably the garnet was analysed by Pollard (Clough [10, p. 34 Analysis 2, table I, represents the composition of an amphibolize eclogite collected by Alderman from the same rock exposure. shows a striking resemblance to that of the eclogite. The thi analysis is that of a kyanite-garnet-amphibolite also collected fro the same outcrop. This rock is comparable with the specimen (Geo Survey slice 8448) referred to by Clough. Its chief distinguishin feature is the high content of alumina. Analyses 4–5 are of

eclogite and its associated sheath of amphibolite from Puy Ferrières. This latter example suffices to show that the transformation of eclogite into amphibolite may be accomplished without notable changes in bulk chemical composition.

The analysis of the kyanite-garnet-amphibolite raises immediately, therefore, the problem of the origin of the high alumina content, and

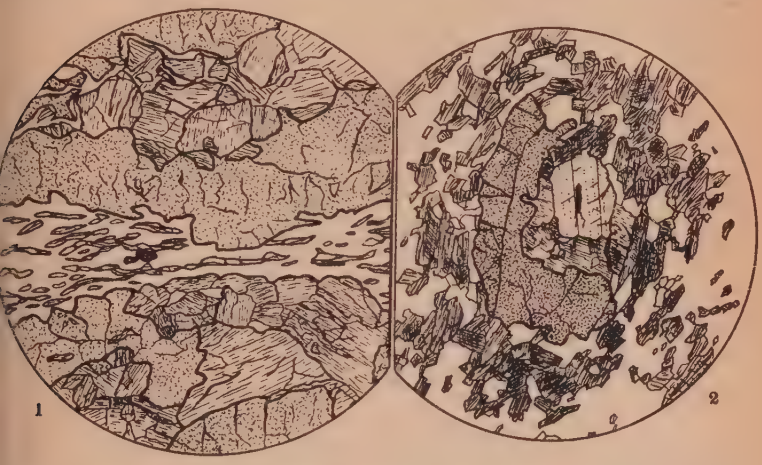

FIG. 1. Eclogite, 530 yards SSE. of Totaig, Loch Duich. The eclogite composed of omphacite and garnet is traversed by a quartz-kyanite streak containing accessory orthoclase (west to east). This streak is built, in the continuation of its course, essentially of orthoclase and kyanite with minor quartz. ×20.

FIG. 2. Kyanite-garnet-amphibolite, ½ mile N. of Ordnance Station, Beinn a Chapuill, Glenelg. Residual garnet partly enwrapping hornblende and kyanite. The ground consists of hornblende, plagioclase, zoisite. ×20.

further discussion of the analyses is required. The analysis of the Glenelg eclogite is that of a normal type, and it falls in its appropriate place among pyroxene-eclogites without excess alumina (text-fig. 3).

The appearance of streaks and venules, composed of oligoclase ± quartz and containing significant kyanite, can legitimately be interpreted as resulting from migration of material during the shearing the eclogites have suffered. The occurrence of streaked eclogites of this character is not limited to this locality in the Glenelg area. A somewhat similar eclogite is recorded from a point approximately ½ mile north of Cnoc Mòr (NE. of Glenelg). Here the streaks consist essentially of oligoclase ± quartz together with prisms of clinozoisite. Kyanite occurs sparingly in these streaks, which may be bordered by

mylonitized quartz. Here the kyanite is being mantled and replac by threads of sericite.

Eclogites from two other localities may be mentioned: (1) ½ mi slightly E. of N. of the NE. end of Lochan na Beinne Faide (932 (2) 530 yards SSE. of Totaig Pier, Loch Duich (9183). Both these roc are contained in the Geological Survey collections, and I am indebted the Director for permission to make reference to them. The form

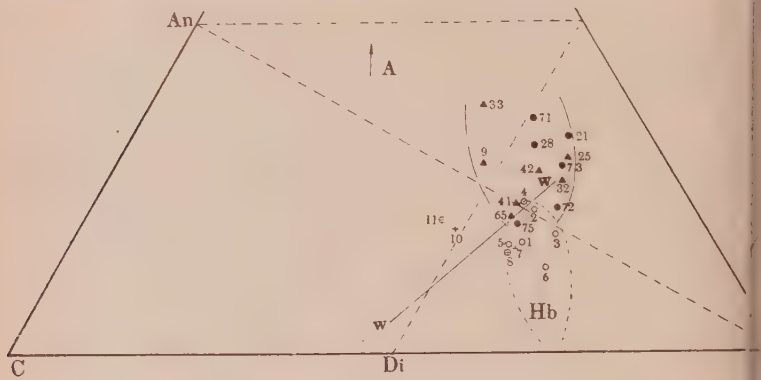

Fig. 3. Plot of analyses referred to in the text.

A-F-C. diagram, cf. fig. 2, Min. Mag., 1936, vol. 24, p. 247. W–W pyroxe garnet conjugation line.—

Hornblendes 1–6 (centred circles); see table IV, p. 566.

Eclogites and amphibolites 7–11 (crosses and encircled crosses respective see table I, p. 560, analyses 1–5.

Kyanite-amphibolite, Glenelg, 9 (black triangle).

Para-amphibolites and hornblende-*Garbenschiefer*, south side of St. Gotth 21–75 (black dots, without kyanite; black triangles, with kyanite); see Ni [2, p. 162] analyses identically numbered.

rock (Geol. Survey slice 9323) is an amphibolized eclogite with stre of oligoclase comparatively rich in parallel orientated kyanite pris In parts of the streaks kyanite is replaced by clinozoisite and may f cores to these crystals. It is probable that these examples could multiplied were a detailed search made for them. An eclogite (M. 3 from Totaig contains nests and narrow streaks of quartz or quartz orthoclase, and in the Survey rock (9183) streaks of this charac contain orientated kyanite prisms (fig. 1). These streaks are borde by a garnet rim. In the nature of the felspar, the unaltered chara of the eclogite—the absence of amphibolization in the vicinity of streaks, these rocks come to differ notably from those just discus

Now it is possible that streaks of this character are more comparable with the quartz (muscovite) kyanite nests that appear as a common feature of the eclogites of the Bavarian Fichtelgebirge, with this difference, however, that in the latter examples kyanite is also a conspicuous mineral in the omphacite-garnet ground of the rock. There is nothing to suggest that this orthoclase represents injected material

TABLE II.

	1.	2.	3.	4.	5.
SiO_2 ...	45·23	46·45	48·78	47·26	45·54
TiO_2 ...	0·59	1·19	0·37	0·38	1·06
Al_2O_3 ...	24·76	21·30	22·07	22·80	23·39
Fe_2O_3 ...	1·87	0·81	1·92	2·21	1·98
FeO ...	7·64	9·57	7·73	5·41	6·98
MnO ...	0·09	trace	trace	0·31	0·27
MgO ...	7·67	7·90	5·22	7·76	4·60
CaO ...	9·18	9·83	9·67	10·93	11·82
Na_2O ...	2·27	2·14	1·81	1·72	2·50
K_2O ...	0·83	0·34	1·17	0·29	0·44
H_2O+ ...	0·24	1·02	1·68	0·90	0·72
H_2O- ...	0·09	0·14	—	0·11	0·62
P_2O_5 ...	—	0·02	0·44	0·06	0·13
CO_2 ...	—	—	—	0·10	—
	100·46	100·75*	100·86	100·24	100·05

Norm of (1)	
Orthoclase ...	5·00
Albite	19·39
Anorthite ...	45·59
Corundum ...	3·26
Hypersthene ...	2·32
Olivine ...	20·48
Magnetite ...	2·78
Ilmenite	1·22
Normative plagioclase An_{70}. II 5.4.4–5.	

* Including NiO 0·04.

1. Kyanite-garnet-amphibolite, ½ mile slightly E. of N. of Ordnance Station, Beinn a Chapuill, Glenelg. [11.]

2. Gabbro, St. Louis Co., Minnesota. Washington's Tables, 1917, p. 532.

3. Gabbro, near Abu Uruf, Kordofan. Ibid., p. 544.

4. Eucrite, Ring dike, Centre 3, Ardnamurchan. Mem. Geol. Surv. Scotland (Ardnamurchan), 1930, p. 85.

5. Dolerite, Coire Buidhe, Mull. Washington's Tables, 1917, p. 538.

rom the surrounding Lewisian gneiss, and it may well be that the otash-felspar represents an original constituent of the eclogite segregated as an accessory mineral of the eclogite facies. Oligoclase, however, is not a typical mineral of this facies and the evidence is very ear that it has developed at a later stage in the history of the rock. it is derived by internal differentiation in metamorphism its source ust be the sodic omphacite which in retrograde metamorphism is nown to give rise to sodic plagioclase.

The analysis of our kyanite-amphibolite can now be examined and mpared with those of genuine igneous rocks. In table II this alysis is set down with analyses of igneous rocks most closely comrable. The composition is unusual inasmuch as the analysis shows

a figure of 3·26 % corundum in the norm which corresponds mor nearly with those of igneous rocks of the type of anorthositic gabbro or allivalites. Most analyses with comparable alumina show, how ever, considerably higher lime percentages. If this amphibolite wer derived from a variant of the eclogite it seems clear that this varian must have been a kyanite-bearing one (Tilley [1]). No such eclogite from the Glenelg region have been revealed by the detailed studie of Alderman, nor in the eclogite exposure north of Beinn a Chapui has kyanite been recognized as an original constituent with omphacit

The presence of kyanite as a subsequently developed mineral i oligoclase streaks and veins in the usual type of eclogite makes ev dent that migration of material is involved and it is pertinent t inquire whether the origin of the kyanite in the amphibolites is n part of the same story. Indeed the mode of development of th kyanite in these rocks—already described—the streaked aggregates closely packed kyanites extending over a length of six or more mill metres—renders the above inference very probable, and it is of intere to note in this connexion that analyses of the eclogite and kyanit amphibolite differ principally in their percentages of alumina. view of the known capacity of kyanite substance to migrate duri stress metamorphism, and the evidence already presented, it is dif cult to refute a belief that the origin of the kyanite in these ampl bolites is to be traced to migration and segregation during the co version of the eclogite to the amphibolite stage.

The break-down of garnet with formation of amphibole togeth with kyanite must involve migration of material, for the proporti of kyanite is much greater than could possibly be derived from chemically closed system; moreover, the garnet has a much great FeO/MgO ratio than the associated amphibole.

Finally, the evidence of eventual replacement of kyanite by clin zoisite—whether in the eclogites or derived amphibolites—may ser to warn us that in other Glenelg occurrences clinozoisite (especial as a constituent of quartz-oligoclase veins or streaks) may similar have arisen on the ruins of former kyanite.

The occurrence of the kyanite-amphibole paragenesis in these ro provides, however—apart from the problem of ultimate genesis—a opportunity of determining how the aluminous environment has co trolled the content of aluminium in the constitution of the amphibo An analysis of the hornblende of the rock analysed has therefore be made.

The amphibole was separated from the other constituents except zoisite by means of heavy liquids, methylene iodide and bromoform mixtures proving suitable liquids. Zoisite was ultimately separated from the amphibole by repeated treatment of the powder in a Hallimond electromagnetic separator. Microscopic examination of the resultant powder showed only hornblende grains, but a few of these

TABLE III. Hornblende from kyanite-garnet-amphibolite, Glenelg.

			Metal atoms to 24(O,OH).		
SiO_2 ...	...	42·28	6·13		8·00
Al_2O_3	...	17·24	2·94	1·87, 1·07	
TiO_2...	...	0·66	0·08		5·16
Fe_2O_3	...	2·68	0·29		
FeO ...	...	9·34	1·12		
MnO...	...	0·12	0·01		
MgO...	...	11·91	2·59		
CaO ...	...	11·06	1·72		
Na_2O	...	1·73	0·47		2·35
K_2O ...	...	0·81	0·16		
H_2O+	...	2·05	1·98		1·98
H_2O-	...	0·08			
		99·96			
Sp. gr.	...	3·20	α 1·648, γ 1·672, $2V_\alpha$ 84°, $c:\gamma = 19°$.		

contained minute needles of kyanite which defied complete separation by the above means. The very small amount of this kyanite was determined by treatment of a weighed quantity of the hornblende powder with hydrofluoric acid *in the cold*. Complete decomposition of the hornblende with kyanite remaining unattacked was obtained. The gelatinous silica was removed by digestion of the washed residue with HCl. The residual material—kyanite showing no signs of chemical attack—was weighed. This residue constituted 0·47 % of the powder and its component oxides were deducted from the analyses of the hornblende fraction. The final analysis thus obtained is given in table III. As was to be expected the hornblende shows a high alumina figure. Comparable alumina percentages are found in certain basaltic and barkevikitic amphiboles of alkali igneous rocks and still higher figures are known from metamorphic rocks. Some of these amphibole analyses are set down in table IV. Here are listed two amphiboles showing 22·73 % and 22·62 % Al_2O_3, the former from a hornblende-*Garbenschiefer* of the Tremola series referred to at the beginning of this paper, the latter from a Hessian basalt (inclusion in).

Hornblende 5 is of interest as it is reported as occurring associate with corundum—in the serpentine belt of Corundum Hill, Nort Carolina. Hornblende 3 with 18·52 % is reported by Sahlstein a developed by reaction between pyroxene and garnet in a Greenlan eclogite.[1]

TABLE IV. Analyses of hornblendes.

	1.	2.	3.	4.	5.	6.
SiO_2... ...	42·28	42·73	41·06	40·09	45·14	42·17
TiO_2... ...	0·66	1·37	0·24	1·17	—	1·00
Al_2O_3 ...	17·24	22·73	18·52	22·62	17·59	13·46
Fe_2O_3 ...	2·68	3·17	4·67	2·44	—	5·92
FeO	9·34	7·62	7·81	9·05	3·45	7·82
MnO ...	0·12	—	0·25	—	—	0·15
MgO... ...	11·91	8·59	15·31	12·40	16·69	14·46
CaO	11·06	9·64	9·92	10·49	12·51	11·76
Na_2O ...	1·73	2·18	1·24	1·17	2·25	0·68
K_2O... ...	0·81	0·98	0·34	0·65	0·36	0·80
H_2O+ ...	2·05	0·97	0·11	0·24	1·34	1·53
H_2O- ...	0·08	0·06	0·46			—
	99·96	100·04	99·93	100·53*	100·33†	99·75

* Including P_2O_5 0·21. † Including Cr_2O_3 0·79, NiO 0·21.

1. Hornblende, from kyanite-garnet-amphibolite, Glenelg. Analyst, H. C. Vincent.

2. Hornblende, from hornblende-*Garbenschiefer*, Airolo, Tessin. L. Hezn [3, p. 157].

3. Hornblende, from eclogite, Hurry Inlet, Greenland. T. G. Sahlstein [1 p. 22].

4. Hornblende, inclusion in basalt, Seigertshausen, north Hesse. C. Trenz [13, p. 37].

5. Hornblende, associated with corundum, serpentine contact, Corundum Hi North Carolina. C. Doelter [14, p. 617].

6. Hornblende, from garnet-amphibolite (of eclogite origin), locality of A. R. Alderman [11, p. 519].

The compositions of these amphiboles together with others fro eclogites and garnet-amphibolites are graphically represented in t plot of text-fig. 3 (p. 562). This plot contains also the co-ordinat for the rocks analysed, together with those of a group of hornblend *Garbenschiefer* and amphibolites ± kyanite. The field demarcat in the upper portion of the figure is characteristically that of sed mentary rocks—in the central region of the field bounded by dolomit

[1] This analysis it should be noted when calculated to the amphibole structu formula yields the abnormally high figure of 6·1 for the 'Y' group (Mg,Fe'',Fe''',Al,Ti...).

muscovite-chlorite (quartz) as could be expressed in this A-F-C diagram. The analysis of the kyanite-amphibolite falls above the join Anorthite-F—appropriately within the region bounded by the four chief phases building the rock, whereas the majority of basic igneous rocks of the composition of eclogites including kyanite-bearing types fall below it.

Appendix.—In my account of kyanite-eclogites [1, p. 430] reference was made to the reported occurrence of sillimanite-bearing kyanite-eclogites from Tanganyika. Since that account was written I have, through the courtesy of Dr. A. W. Rogers and Mr. A. F. Williams, had opportunity of examining some of the original material from the Mabuki mine, Tanganyika. This examination has shown that in the rocks in question the only aluminium silicate mineral present is kyanite occurring in part as elongated prismatic crystals which in appropriate sections show almost zero extinction.

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Explanation of Plate XX.

Kyanite-garnet-amphibolites and eclogite from Glenelg, Inverness-shire.

Fig. 1. Eclogite, ½ mile north of Ordnance Station, Beinn a Chapuill, Glenel The rock is veined by fine-grained oligoclase-kyanite streaks. In this examp the streaks are more strongly developed than usual. Dark spots in the whi streaks are garnets isolated from the main body of the eclogite. ×⅔.

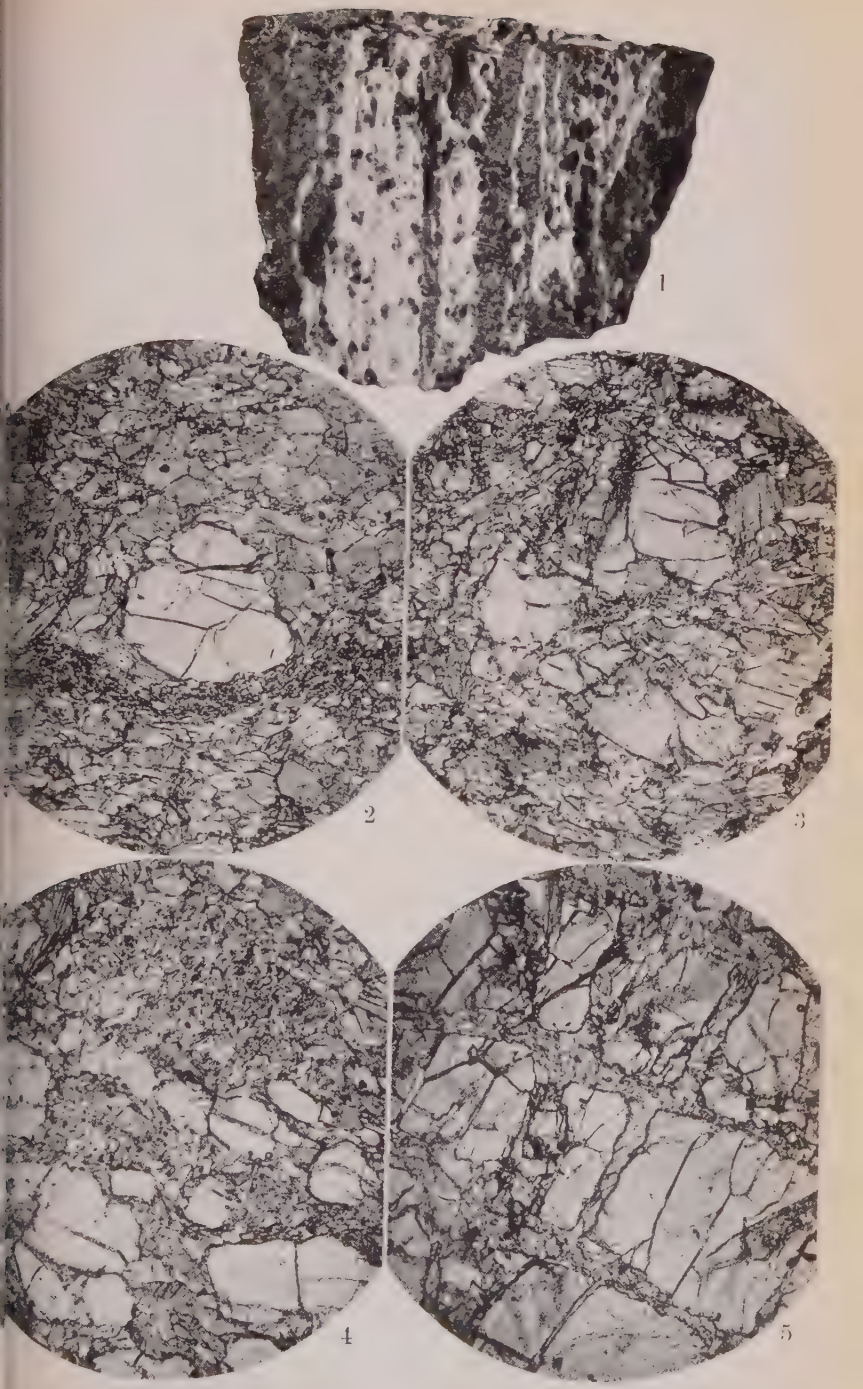
Fig. 2. Kyanite-garnet-amphibolite, same locality. Streaked aggregates kyanite form a darker coloured band below the central garnet. Kyanite present as isolated crystals in the hornblende ground. ×20.

Fig. 3. Kyanite-garnet-amphibolite, same locality. Residua of garnet a abundant kyanite. The dark zones traversing the garnet of the upper cent and top right consist of fine hornblende with numerous kyanite prisms. ×20

Fig. 4. Kyanite-garnet-amphibolite, same locality. Residua of garnet a abundant kyanite in the form of closely packed aggregates (left centre and the upper half of the photograph). ×20.

Fig. 5. Kyanite-garnet-amphibolite, same locality. Garnet in process replacement by hornblende with numerous fine crystals of kyanite. The lat are well seen in the fractures directed across the photograph from left right. ×20.

Plate XX.



C. E. TILLEY : KYANITE-AMPHIBOLITES

Wollastonite solid solutions from Scawt Hill, Co. Antrim.

By C. E. Tilley, Ph.D., B.Sc.
Professor of Mineralogy and Petrology, University of Cambridge.

[Read June 24, 1937.]

WOLLASTONITE at Scawt Hill, Co. Antrim, occurs as a constituent of both the exogeneous and endogeneous contact-zones of the dolerite.[1] In the former it is associated only with flint nodules in the metamorphosed chalk, in the latter, however, commonly as a minor constituent of certain of the hybrid types.

In my original account a wollastonite-bearing augite-dolerite from this latter zone was figured without further description in the text (plate xvii, fig. 3). In examining the optical characters of wollastonites associated with hedenbergite, I had occasion to turn again to the wollastonites of this particular rock type.

As indicated in the explanation of the figured section (loc. cit., p. 467), the dolerite is built essentially of sharply zoned brown titan-augite, labradorite, wollastonite, iron-ores, interstitial thomsonite, analcime, and accessory sphene. In this aggregate wollastonite forms subidiomorphic crystals averaging 1 mm. in size, and from a series of sections its predominant forms can be readily made out. As seen in cross-sections the chief forms developed in the ortho-zone are a (100), c (001), v (101), α ($10\bar{2}$), with usually prominent development of (001) and (100), less commonly (101). Such sections provide material for the determination of the optical orientation. They are sensibly normal to the axis β. Crystallographically these Scawt Hill wollastonites agree with the normal wollastonite, but the sections reveal that there are significant optical departures. In normal wollastonite $a : c = 32°$, but these sections reveal that the extinction-angle is invariably greater than 32°, and has usually values greater than 40°.

In a series of sections, a common value is $a : c = 43°$, bringing the axis γ almost perpendicular to the face v (101), repeatedly observed

[1] C. E. Tilley, Min. Mag., 1931, vol. 22, p. 439.

as an edge. These results required a closer investigation of th refractive indices of the material. By use of immersion liquids becomes clear that the wollastonites of this rock have variable re fractive indices. This is further emphasized by the occurrence cleavage fragments showing parallel growths with noticeably differer refraction. The highest values recorded in this variable materia determined on homogeneous cleavage fragments were α 1·646, γ 1·66 In sections normal to the acute bisectrix these high refracting wo lastonites show a distinct oblique extinction, values up to 6° fro the zone of cleavages being recorded. A section orientated norm to β isolated from a rock section was found to possess refracti indices α 1·642, γ 1·657, $\alpha : c = 44°$. Furthermore, these wollasto ites show high optic axial angles. In five sections examined 2V h a value varying between 60° and 63° (cf. wollastonite, 2V 40°).

A striking feature of the rock is the strongly zoned character of i minerals. This statement applies both to the plagioclase and t pyroxene. In the latter, the zones are sharply defined and n gradational, a lighter core being surrounded by a dark-coloured she In many of the wollastonites a similar sharp zoning is to be observe brought out both by varying extinction and interference-tint as w as by refraction. The core, often of irregular shape as if resorbe has a lower refraction than the shell. Cross-sections of such mater show a core with γ 1·640, $\alpha : c = 36°$, followed by a shell wi γ 1·658, $\alpha : c = 44°$. In some cases the zones are less regular developed. Determinations of 2V in core and shell show that t core has a distinctly lower optic axial angle. In two such zon sections examined the core has 2V 46–47°, and the shell 2V 60–6

Wollastonites with these optical characters have not so far be recorded among rocks, but the recent work of Bowen, Schairer, a Posnjak [1] on synthetic melts of the system CaO–FeO–SiO_2 has sho that similar optics are obtained from the synthetic wollaston crystals in which solid solutions with $FeSiO_3$ are involved. In t system $CaSiO_3$–$FeSiO_3$ wollastonite solid solutions with a maximu content of 76 wt. % $FeSiO_3$ were obtained, the refraction, optic ax angle, and extinction-angle (measured against the zone of cleavag increasing with rising iron content. In this binary system a so solution with refractive indices comparable with the highest obtai from the Scawt Hill wollastonites contains approximately 25 wt

[1] N. L. Bowen, J. F. Schairer, and E. Posnjak, Amer. Journ. Sci., 19 ser. 5, vol. 26, p. 193. [M.A. 5–454.]

$FeSiO_3$. Ferguson and Merwin [1] report wollastonite solid solutions in the system CaO–MgO–SiO_2, and the maximum content of dissolved substance is reported by them as equivalent to 17 % diopside. In a later study Schairer and Bowen [2] state that solid solution rises to 22 wt. % diopside. The former authors give the optical characters of wollastonite with the maximum amount of dissolved material as α 1·619, β 1·631, γ 1·634, 2V 40–65°.

FIG. 1. Wollastonite-bearing dolerite, Scawt Hill, Co. Antrim.

Showing two zoned crystals of wollastonite: (1) with dark core and light periphery; (2) slightly darker core (extinction $\alpha : c = 36°$) and lighter coloured periphery (extinction $\alpha : c = 43°$). The remaining constituents are augite, labradorite, iron-ores, and thomsonite (centre). Crossed nicols. ×34.

As might be expected, the refractive indices of the iron-bearing wollastonites rise more rapidly with increasing iron than the magnesian-bearing varieties do with increasing magnesia. The optical characters of the Scawt Hill wollastonites is to be ascribed to solid solution in which, considering the chemical environment of

[1] J. B. Ferguson and H. E. Merwin, Amer. Journ. Sci., 1919, ser. 4, vol. 48, p. 92. [M.A. 1–168.]

[2] J. F. Schairer and N. L. Bowen, Amer. Min., 1936, vol. 21, p. 193 (abstract only).

their growth, probably iron and magnesia play a part. The sol
solution is doubtless of a more complex character than that of the
synthetic analogues, but, considering the iron-rich character (not
pared to magnesia) of the Scawt Hill hybrids carrying a simil
manganite as the rock in which they are developed, it is probab
that they are essentially iron-wollastonites. In fine powder much
the wollastonite separates with the pyroxene in the electromagne
separator, and with heavy liquids crystals appear in a light a
heavy fraction. Small crystals isolated from these fractions ga
specific gravities of 2·91 and 3·11 respectively. A micro-chemi
test with potassium ferrocyanide showed the presence of iron. Insu
exact material, however, is available to extract these wollastonit
from the rock for chemical analysis.

By analogy with the properties of the synthetic solid solutions,
shells of zoned crystals with higher refraction and optic axial an
represent iron-wollastonites of higher iron content than the cor
Wollastonites of this character do not occur in the exogenous o
zone of Scawt Hill and are only recorded now from the hyb
rocks carrying manganite. Of the three types of association of
Scawt Hill wollastonites the environment of the latter corresp
to that of the highest temperature and, as might be expected
that of most extended solid solution.

In the synthetic system $CaSiO_3$–$FeSiO_3$ the course of the inver
curve wollastonite solid solution → hedenbergite was approxima
determined. The results show that, even at temperatures of 50
wollastonites might be expected to contain up to 20% $FeSiO_3$
solid solution. In the more complex natural system solid solut
of the character now described were doubtless stable to the clos
the consolidation of the rock containing them, below which,
metastability region is entered, unmixing would be inhibited
virtue of slow reaction at lowered temperatures.

'Iron-rhodonite' (from slag) and pyroxmangite and their relation to rhodonite.

By Max Perutz
Crystallographic Laboratory, University of Cambridge.

[Read March 11, 1937; communicated by Professor C. E. Tilley.]

THE pyroxmangite and rhodonite, here examined by X-ray methods, are from the Lewisian schists at Glen Beag, in the Glenelg district, Inverness-shire. The material was exhibited by Prof. C. E. Tilley at the meeting of the Society on November 5, 1936, and it has since been described by him.[1] The specimen of 'iron-rhodonite' was from the iron slag described by Whiteley and Hallimond, and is no. 7a in their table of analyses.[2]

The unit cell of the 'iron-rhodonite' was determined by means of the Weissenberg goniometer and the data obtained are compared in table I with Gossner and Brückl's determination for rhodonite.[3] The

Table I.

	Rhodonite.	'Iron-rhodonite.'	Pyroxmangite.
a	7·77 Å.	7·49 Å.	7·4 Å.
b	12·45	17·2	17·1
c	6·74	6·81	6·7
α	85° 10′	82° 48′	83°
β	94 4	94 20	94
γ	111 29	113 17	113

		a : b : c
Axial ratios	Rhodonite	0·624 : 1 : 0·541
	'Iron-rhodonite' ...	0·435 : 1 : 0·396
	Pyroxmangite	0·43 : 1 : 0·39

unit cell of pyroxmangite was determined by taking a Weissenberg photograph about the c-axis and oscillation photographs about the a- and b-axes. It has not been possible to determine the cell-dimensions of pyroxmangite as exactly as those of 'iron-rhodonite', since only very imperfect cleavage fragments were available; the

[1] C. E. Tilley, Amer. Min., 1937, vol. 22, p. 720. [Min. Abstr. 6–528.]
[2] J. H. Whiteley and A. F. Hallimond, Journ. Iron and Steel Inst., London, 1919, vol. 99, p. 201. [M.A. 1–164.]
[3] B. Gossner and K. Brückl, Centr. Min., Abt. A, 1928, p. 316. [M.A. 4–108.]

spacings and angles have here to be taken as ±0·1 A. and ±1
respectively.

Oscillation photographs have also been taken about the *a*-, *b*-, an
c-axes of the three minerals. The patterns of reflections on th
photographs of 'iron-rhodonite' and pyroxmangite are identical an
the corresponding intensities are very similar. On the photograph
of rhodonite fundamental variations can be observed in the arrang
ment of the spots and in their relative intensities, apart from th
large difference in the length of the *b*-axis.

Table II shows the intensities of the corresponding reflections
rhodonite, pyroxmangite, and 'iron-rhodonite' on Weissenbe
diagrams taken about the *c*-axis. Columns 4 and 5 show th
intensities on Weissenberg diagrams of 'iron-rhodonite' taken abou
the *a*- and *b*-axes; they may be helpful in further structure work c
the mineral.

The data obtained show that the structure of the slag 'iro
rhodonite' of Whiteley and Hallimond is the same as that of pyro
mangite. On the other hand, there can be no doubt that rhodoni
does not belong to the same solid solution series, although it sho
many features in common. G. Tunell has already suggested th
difference between pyroxmangite and rhodonite after examination
the powder photographs of the two minerals.[1]

TABLE II.

Rhodonite *c*-axis.		Pyroxmangite *c*-axis.		'Iron-rhodonite' *c*-axis.		*b*-axis.		*a*-axis.	
030	—	030	mw	030	w	001	w	030	v
050	vvw	050	—	050	—	002	s	070	v
070	m	070	vw	070	vw	003	ms	080	v
080	—	080	vvw	080	vvw	004	vvw	090	v
090	—	090	w	090	w	007	vw	0.10.0	
0.10.0	—	0.10.0	s	0.10.0	ms	008	vvw	0.14.0	v
100	w	100	—	100	w	100	m	0.17.0	v
200	s	200	m	200	m	200	ms	001	
300	m	300	w	300	mw	300	vw	002	
400	w	400	—	400	—	$10\bar{5}$	w	003	
$1.\bar{1}0.0$	w	$1\bar{6}0$	vvw	$1.\bar{1}4.0$	w	101	s	015	m
$1\bar{8}0$	vw	$1\bar{5}0$	vvw	$1\bar{5}0$	—	102	s	014	
$1\bar{3}0$	s	$1\bar{4}0$	vs	$1\bar{4}0$	s	104	w	013	
$1\bar{2}0$	vvw	$1\bar{3}0$	w	$1\bar{3}0$	—	106	vvw	026	

s = strong, m = medium, w = weak, vs = very strong, &c.

[1] G. Tunell in E. P. Henderson and J. J. Glass, Amer. Min., 1936, vol.
p. 293. [M.A. 6-528.]

TABLE II (*continued*).

Rhodonite		Pyroxmangite		'Iron-rhodonite'					
c-axis.		*c*-axis.		*c*-axis.		*b*-axis.		*a*-axis.	
140	vw	160	vw	160	vw	107	vvw	027	m
170	s	1.10.0	vs	1.10.0	vs	108	vvw	$02\bar{4}$	vs
$2\bar{6}0$	vw	$2\bar{4}0$	m	$2\bar{4}0$	ms	$20\bar{3}$	vw	$02\bar{3}$	w
$2\bar{3}0$	ms	$2\bar{1}0$	m	$2\bar{1}0$	m	201	vs	$02\bar{2}$	w
$2\bar{2}0$	vvw	230	—	230	vw	202	w	033	vw
$2\bar{1}0$	m	240	vw	240	vw	203	m	$03\bar{2}$	w
220	vw	250	mw	250	mw	$30\bar{2}$	w	$03\bar{3}$	w
230	vw	260	vvs	260	vvs	303	ms	043	w
240	vs	270	vw	270	vw	304	w	042	mw
250	w	280	vw	280	—	305	vw	$05\bar{4}$	m
2.10.0	vw	290	w	290	w	306	vvw	054	w
2.11.0	vw	2.13.0	vw	2.13.0	w	$40\bar{1}$	w	067	ms
$2.\bar{1}0.0$	vvw	2.14.0	w	2.14.0	w	403	m	066	w
$3\bar{3}0$	mw	2.16.0	vw	2.16.0	mv	404	m	$06\bar{2}$	s
$3\bar{2}0$	w	$3\bar{4}0$	vvw	$3\bar{4}0$	vw	$50\bar{2}$	w	084	w
310	ms	310	w	310	mw	506	w	083	w
320	w	320	mw	320	m	505	s	082	w
340	w	330	w	330	mw	601	m	0.10.2	vvw
3.11.0	w	360	ms	360	mw	606	w	$0.10.\bar{1}$	m
$4\bar{9}0$	vvw	390	vw	$4\bar{8}0$	w			$0.10.\bar{2}$	w
$4\bar{2}0$	s	3.16.0	w	$4\bar{2}0$	m			$0.11.\bar{1}$	mw
410	m	420	w	420	ms			0.11.1	ms
440	vw	460	w	450	w			0.12.6	m
480	w	4.12.0	m	460	w			$0.12.\bar{4}$	vw
490	vw	4.13.0	m	4.12.0	mw			0.14.2	w
1610	s			4.13.0	mw			0.14.1	s
1550	m			$5\bar{7}0$	vw			0.15.2	m
1610	w			$5\bar{6}0$	vvw			0.16.2	vw
1520	mw			$5\bar{2}0$	w			0.16.3	w
1710	w			530	vw				
1720	vw			5.10.0	vvw				
				$6\bar{2}0$	w				
				630	vw				
				640	vw				
				740	vw				

s = strong, m = medium, w = weak, vs = very strong, &c.

The indices of the planes are given according to Gossner and Brückl's orientation for rhodonite, in which (100), (010), and (001) correspond to $(\bar{1}10)$, $(00\bar{1})$, and $(1\bar{1}0)$ respectively referred to the axes of G. Flink (1885), as adopted in the treatises of Dana and Hintze. The first principal cleavage of all our fragments is parallel to (100), and the second principal cleavage is parallel to (001).

There is a marked similarity between the cleavage-zone distances

of 'iron-rhodonite' and enstatite if the indices are correlated so tha the first principal cleavages coincide.

'Iron-rhodonite' ...	9·7 [101] ...	10·4 [10$\bar{1}$]
Enstatite	8·8 [010] ...	9·1 [200]

The cell-volume V of 'iron-rhodonite' has been calculated, and it specific gravity determined by suspension in Clerici solution. Th values of V, d, and the mass of the cell m show the followin comparison with the values obtained by Gossner and Brückl fo rhodonite:

	V.	d.	$\frac{m}{H\ (=1\cdot662\times10^{-24})}$.
'Iron-rhodonite' ...	866 Å.^{3}	3·79	1970
Rhodonite	605	3·65	1345

It has not yet been possible to determine n, the number of mol cules in the cell, with certainty, as the chemical composition is onl partly known. Only the percentages of FeO (35·0) and MnO (14·4 were determined by J. H. Whiteley, and we know that the remaind is composed of $CaSiO_3$ and $MgSiO_3$. The following rough comput tion gives $n = 15{\cdot}3$, suggesting the possibility that the number (Fe,Mn,Mg,Ca)SiO_3 molecules in the cell might be 16, which corr sponds to the number of $MgSiO_3$ molecules in enstatite.

	Percentage of weight.	Molecular ratios.	n.
$FeSiO_3$ ...	64·2	0·487	9·7
$MnSiO_3$ ...	26·8	0·204	4·0
$MgSiO_3$, $CaSiO_3$ ...	9·0	0·083	1·6
	100·0		15·3

I am greatly indebted to Mr. J. D. Bernal, F.R.S., for his helpf advice, and I must also thank Professor C. E. Tilley for supplyi the material and for his friendly encouragement.

An integrating micrometer for the geometrical analysis of rocks.

By A. T. J. Dollar, Ph.D., B.Sc., A.K.C.
Research Fellow of Emmanuel College, Cambridge.

[Read November 5, 1936.]

THIS instrument is a microscope stage-micrometer for the quantitative estimation of one to six different kinds of constituents in a substance, by the Delesse-Rosiwal [1] method. It is intended, primarily, for linear micrometric analysis in petrography, but has similar uses in mineralogy, chemistry, and metallography. Economic applications include the volumetric evaluation of components in building stones, road-metals, solid fuels, refractories, and slags.

The object of this new design is to combine speed and accuracy in operation with a particularly compact construction, mechanical simplicity, and strength. Special consideration has been given to the wear and cleansing of bearings, the definition of scale-divisions and zero-marks, and the rigidity of all supports for moving parts.

In use, the instrument measures to 0·01 mm., and automatically adds the successive intercepts of one to six distinct varieties of constituents on straight lines within an area of 25 × 22 mm. This it performed with equal ease upon polished fragments, thin-sections, preparations of crushed materials or detrital grains, whether mounted on English or Continental object-slides. It carries the substance backwards and forwards below the microscope objective in parallel straight lines which are 25 mm. long and spaced conveniently, within a distance of 22 mm., by means of a scale and vernier reading to 0·1 mm.

Though similar in certain respects, it differs from the petrographic micrometers of Prof. S. J. Shand [2], C. K. Wentworth [3], and Messrs. E. Leitz [4] in utilizing the 'travelling nut' method of measuring and summing lengths, in the fact that only *one* micrometer screw is employed throughout, and in the further fact that the whole instrument can be turned through 360° on the rotating stage of almost any modern petrographic microscope.

The first design of the present model was developed in Augus 1936,[1] after six months of experiment with a type involving a flui mechanism.

Existing Designs.

The basic principle underlying the utility of this, and previou petrographic micrometers of the Shand type, is that proportionalit can be taken to exist between linear intercepts and volumes of co stituents in a heterogeneous substance, provided all the constituen encountered are identified correctly and a sufficient number of the intercepts is measured in suitable directions. The validity of this pri ciple was examined mathematically by A. Rosiwal [1 b], F. C. Linco and H. L. Rietz [5], A. Johannsen [6], and E. P. Polushkin [7]. It w tested experimentally by A. Johannsen and Stephenson [8], F. From [9], W. F. Hunt [10], H. L. Alling and W. G. Valentine [11], A. Holm [12], E. Thomson [13], and F. E. Thackwell [14], among others.

The chief difficulty in designing microscope stage-micrometers f measuring and adding linear intercepts is to find means whereby specimen can be moved, at will, through a desired distance below objective by any one at a time of several identical measuring a recording devices, such as micrometer screws.

First among designs of such micrometers was that produced Prof. S. J. Shand, in 1916, to be followed by the more elabor designs of C. K. Wentworth and Messrs. E. Leitz, in 1923 and 19 respectively. The merits of all these instruments are numerous, experience has shown, but they have certain disadvantages, includ their considerable length, which prevents them from being rota through 360° on a microscope, their undesirable leverage w attached to an unclamped microscope stage, and their relatively h cost. Further, their operation depends upon more than one mic meter screw-thread, with attendant possibilities of error; early ty have inadequate means for compensating wear in the main scr bearings, and two of them require special modes of attachment t microscope stage.

The New Design.

Between 1935 and 1936 a new design was sought by the aut to overcome some or all of these drawbacks, while combining adequ accuracy with simplicity and durability. Secondary aims were enable the instrument to (*a*) be attached to a microscope in a

[1] The instrument, and its modifications, were constructed by Unicam Ins ments Ltd., Arbury Road, Cambridge.

seconds, without the necessity for special stage-fittings; (*b*) be capable of being operated by touch alone; (*c*) measure and record, simultaneously, up to six different kinds of constituents with an accuracy of 0·01 mm., during either right-to-left, or left-to-right, traverses of the specimen below the microscope objective; (*d*) record and be reset rapidly; (*e*) yield direct readings on all scales, without need for numerical conversions; and (*f*) accommodate either English or Continental object-slides. Further, it was desired that the instrument should be easy and inexpensive to manufacture, light in weight, and sufficiently robust to withstand handling by relatively inexperienced students as well as by advanced workers.

(*a*) *Principle.*—In this design, what has been called the 'travelling-nut' method of measuring and recording intercepts is fundamental: it may be explained as follows. If a drum-shaped nut is threaded on the part of a micrometer screw which is supported horizontally between two threaded bearings, and one edge of the nut coincides with a mark on a fixed scale set up parallel to the axis of the screw, then provided the nut is prevented from revolving by a suitable brake, it will not rotate or be translated when the screw is turned a small number of times in either one of two possible directions. If, however, the brake is lifted, and there is no slip between nut and screw, the nut will be carried by the screw away from the mark on the fixed scale by an amount equal to the translation of the screw through the bearings from the moment when the brake was lifted. Thus, relative to the mark on the fixed scale, the nut will continue to record the motion of the screw until either the screw ceases to move, or the brake is reapplied to the nut, or the nut meets one of the screw-bearings.

If, as in the instrument to be described, *six* identical nuts of this kind are threaded on the same part of the screw, at suitable intervals, each controlled by its own brake and placed opposite its own mark on the fixed scale, then small consecutive translations of the screw can be recorded by releasing and reclamping some, or all, of the six nuts, in any desired order, one at a time. This means that up to six sets of translations, corresponding to as many different sets of intercepts, can be measured and added together, any one set by any one particular nut. In practice, the number of kinds of constituents in a specimen is determined by preliminary inspection, the requisite number of nuts allocated to the recording of six, or less than six, corresponding sets of intercepts and the specimen placed in a holder attached to the micrometer screw. As the specimen is carried by the revolving screw

below a microscope-objective, in the eyepiece of the microscope th
images of constituents along the line of the image of the horizonta
cross-wire move past the image of the vertical cross-wire one by one
Considering any given constituent, immediately the image of it
nearer boundary, in the line of traverse, is tangential to the image c
the vertical cross-wire the brake is lifted from the nut allocated fo

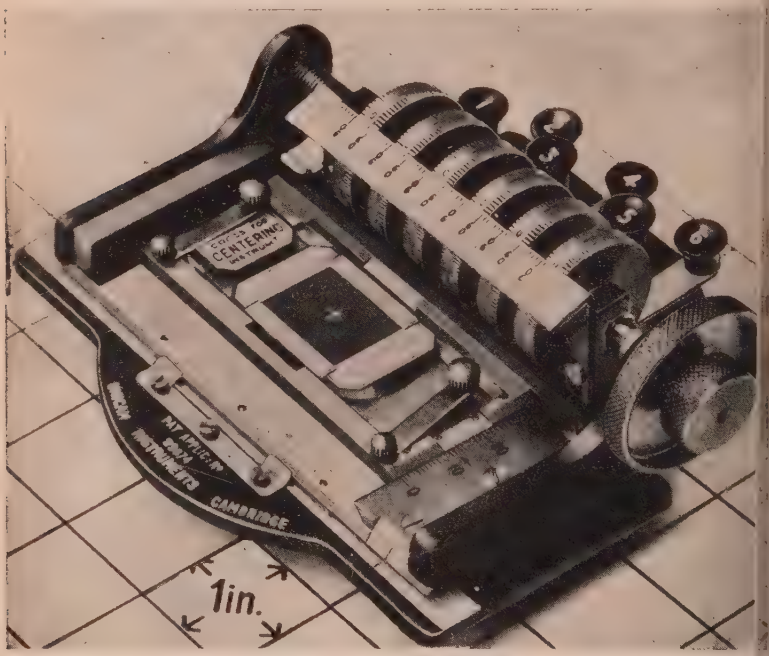


FIG. 1. Front view, showing details of large and small frames, scales, and turning-head.

recording intercepts of this kind of constituent and the nut begi
to travel with the screw. The instant the image of the *farther* bounda
of the constituent reaches, and becomes tangential to, the image
the cross-wire, the brake is allowed to return and clamp the nu
Meanwhile, the nut has been carried by the screw a distance equal
the intercept of the constituent on the line of traverse. This proce
is repeated for all other constituents on the line, the appropriate nu
being unclamped and clamped again as often as is necessary, un
the end of the traverse is reached, when the total distances travell
by each nut are read on suitable scales and written down. Final

totals of measurements carried out along a sufficient number of suitably spaced and oriented straight parallel traverses in the requisite thin-sections, or other samples, will indicate the relative proportions,

FIG. 2. The instrument in the operating position on a microscope stage.

y volume, of different constituents encountered, in terms of integrated ntercepts of the latter. If due precautions have been observed, these olumes should be representative of the bulk of the specimen conrned.

In common with that employed by C. K. Wentworth and Messrs. E. eitz, this method of measurement obviates errors arising from the

accidental remeasurement of a series of constituents, the diagnosti characters of which are doubtful or ambiguous, such as may occu when only one or two kinds of constituents are determined at a tim along a given traverse line, or series of such lines, in the specimen.

(*b*) *Construction.*—From the accompanying figures it will be ap parent that the instrument consists of a sub-rectangular base plate (1 with an annulus (2) and pair of ribs (3) on its lower surface, and tw identical vertical columns (4) on its upper surface which support, i horizontal threaded bearings, a steel micrometer screw (5) carryin six divided drum-nuts (6) and a large brass frame (7) bearing upon a smaller brass frame (8).

The base plate, annulus, and its extensions are integral parts of single aluminium casting, to combine lightness and strength with eas and cheapness of manufacture. Near the centre of the plate is circular hole (9) intended to coincide with the axial hole in a micr scope stage, and surrounding this, on the lower surface, is th annulus (2), relieved of superfluous metal, with two parallel ribs (extending from it, at the ends of a diameter. The functions of th annulus are to contain the attachment mechanism of the instrumen to raise the base plate sufficiently above the surface of a revolvi stage to avoid obscuring, or otherwise interfering with, its peripher scale, vernier scale, or clamp, and to strengthen the plate about th central hole. The parallel ribs (3), being of the same depth as th annulus, prevent the base plate from tilting on a stage when the brak keys (17), which control the drum-nuts, are depressed above the rib

The mechanism of attachment in the annulus consists of thr short cylindrical rods (10) of brass, sliding in holes parallel to th plane of the base plate and disposed radially with an angular diffe ence of 120° between any adjacent pair. Riveted at right angles those ends of the rods nearest the centre of the annulus are sma brass plates (11), each with a stiff rectangular 'jaw' (12) projecti from it a short distance below the lower surface of the annulu Pins (13) attached to the jaw-plates (11), and sliding in holes the annulus, prevent the rods (10) from revolving while allowi them to slide in the directions of their lengths. Suitable bevels the faces of the jaws which meet the edge of the central hole in microscope stage cause the instrument to be drawn into intima contact with the stage as well as being held stationary in the pla of the same. Springs (14) of steel wire are fitted to the rods in ord to return them towards the centre of the annulus whenever th

nuts (15) are revolved in the appropriate direction. The nuts themselves are tapered at the ends remote from the annulus, so that, automatically, these ends, and then the edges, are guided into the angles of a small cylindrical box-spanner, when necessary. The knurled handle of the latter has been made small in diameter to reduce leverage and consequent possibilities of bending the jaws.

The pair of vertical brass supports (4) screwed to the upper surface of the base plate retain an accurate steel micrometer screw (5) in horizontal threaded bearings (16). In profile the latter resemble the upper part of an 'S', having more than half of their bearing surfaces cut away to reduce frictional resistance and wear, as well as to facilitate cleaning and any necessary repairs. Normally, pressure exerted by six spring brakes against drum-nuts (6) threaded on the screw maintains the latter in position and eliminates 'play' due to wear in either the screw or its bearings. During recording, however, the screw is held in position, at any given instant, by pressure from a group of five spring-brakes (17). As a result, the screw, complete with its appended frames (7, 8), can be released from its bearings in a few moments by removing the plate (18) carrying all the spring-brakes, and also the small spring (19) on the base plate which presses against one edge of the large brass frame (7). These relieved bearings were developed and adapted after simple threaded bearings, split bearings, and partly relieved geometric bearings had been tested and rejected. A straight narrow channel (50) has been cut across the threads of these bearings (16), parallel to the length of the screw, where wear due to pressure from the spring-brakes (17) would be a maximum. In this way, localized wear, and any consequent tendency for 'rocking' of the screw in its bearings, is avoided. The screw is revolved through the bearings in either direction by means of a brass turning-head having two co-axial knurled surfaces of differing diameters. The surface of larger diameter (20) facilitates the making of small motions, such as are necessary in the recording of individual intercepts of constituents; the surface of smaller diameter (21) makes it possible to increase the rate at which the screw is returned to one extreme position after it has been moved to the other extreme position during recording.

The accurate micrometer screw (5) has a diameter of $\frac{5}{16}$ inch and a thread of 1 mm. pitch, cut and finished by a precision screw-cutting lathe. On the part of the screw between its bearings are threaded six identical brass drum-nuts (6) from each of which superfluous metal

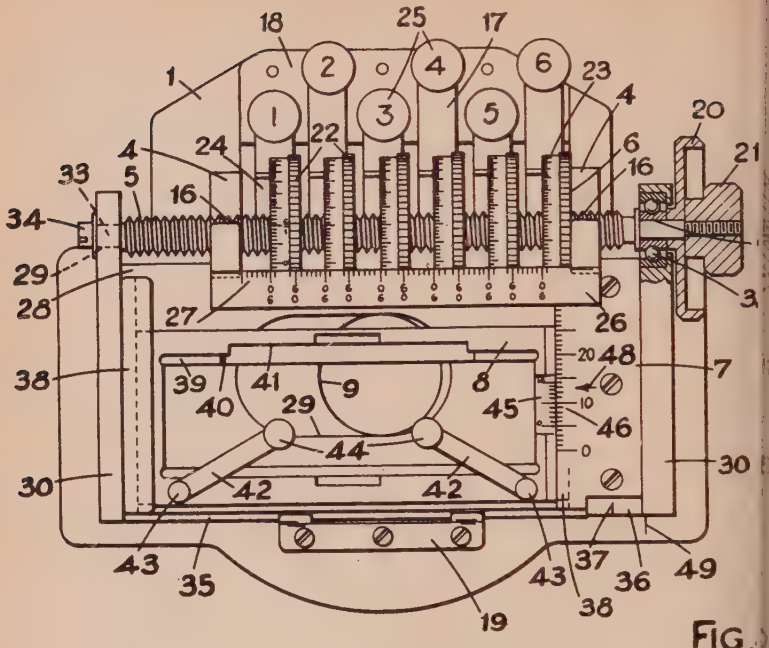


FIG.

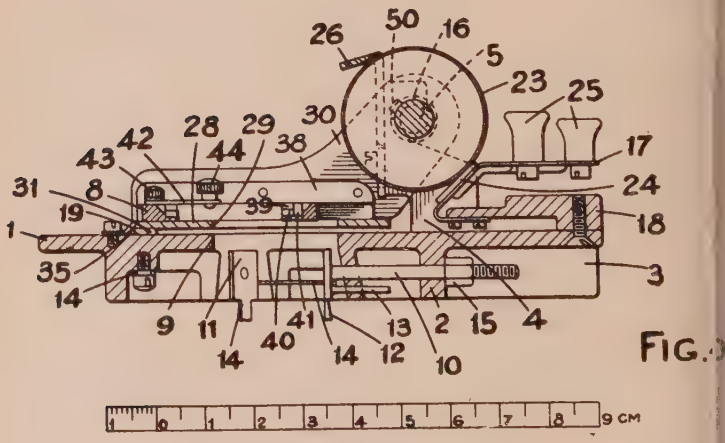


FIG.

Fig. 3. Plan of upper surface.

Fig. 4. Vertical section through the middle of the instrument, viewed towards the left.

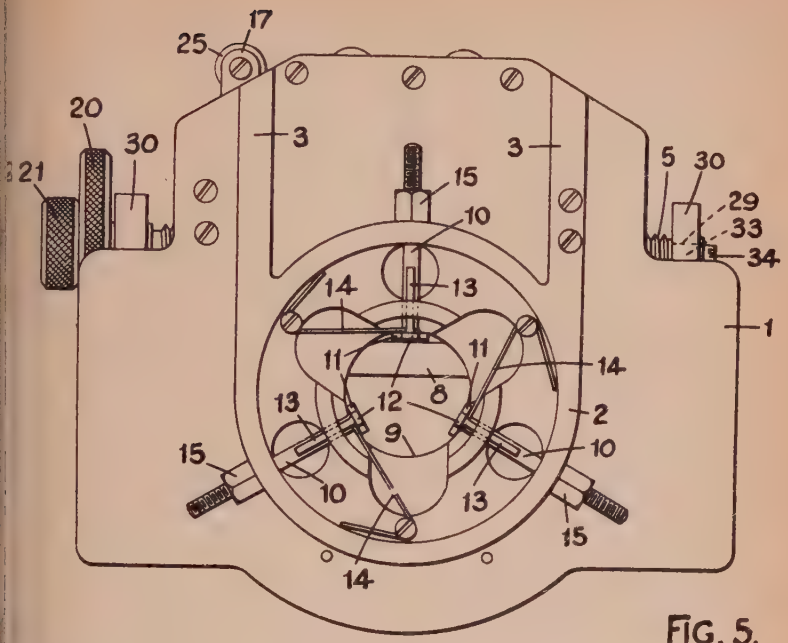


FIG. 5.

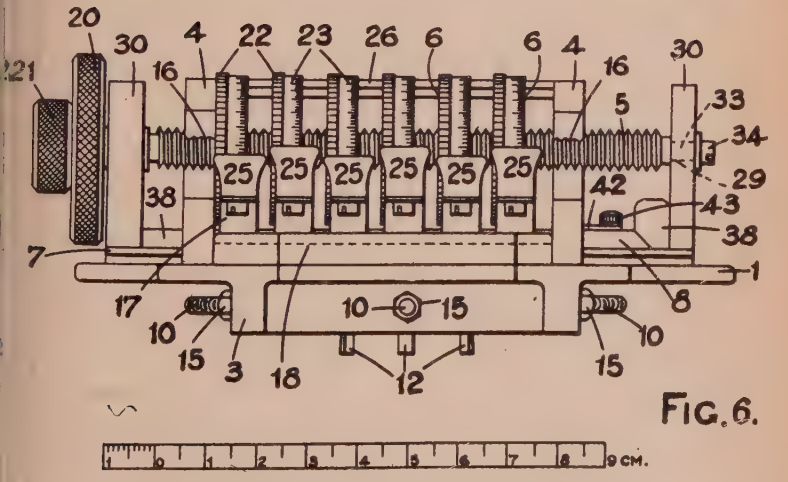


FIG. 6.

FIG. 5. Plan of lower surface.

FIG. 6. Back view.

has been removed, to leave a light, cylindrical shell, of adequat strength, with a sprung central bearing. The curved surface of eac nut is divided circumferentially into two parts: a narrow mille flange (22), in contact with one edge of the nut and projecting 0·5 mm above the other and wider part of this surface (23), which latter divided into a hundred equal parts by graduations cut to meet th other edge in a direction parallel to the axis of rotation. Eve tenth graduation, except the zero graduation and fiftieth graduatio has two numbers, one of which belongs to a clockwise series and t other to an anti-clockwise series, so that the drum-nuts can measu and record distances when the screw is rotated in either directio The zero graduation is marked by a conspicuous red dot, to facilita initial settings: the fiftieth graduation is marked with a single '5 as it indicates the centre of both series of numbers. By virtue of t pitch of the screw, one complete revolution of any drum-nut repr sents a motion of 1 mm. by the screw through its bearings, and ea graduation on the periphery of any such nut therefore indicates motion of 0·01 mm.

On the side of the micrometer screw remote from the cent hole (9) in the base plate are six uniformly spaced spring-brakes (of phosphor-bronze strip, each of which is capable of meeting ta gentially and holding the milled flange (22) of its appropriate dru nut through the agency of a small strip of fibre sheet (24), riveted the brake at a suitable point. The lower ends of all the brakes are b away from the drum-nuts, round the edge of a horizontal plate (and attached to its lower side. This plate is screwed to the m base plate. The upper ends of these brakes are bent parallel w the base plate, away from the drum-nuts, to form keys (17), on free ends of which are numbered thumb-buttons (25). Three l keys alternate with three short keys, and the free ends of the t groups are at different levels so that any of the six buttons (25) be found by sense of touch alone after some little practice. displacement of a brake-key necessary to release a drum-nut been made about 3 mm., to save time in use, and lengthen the of the key.

Nearly in contact with the graduated surfaces of the drum-nut an adjustable scale-support (26), parallel to the micrometer screw and attached to the main columns (4) by lugs. On the edge clos to the drum-nuts are six consecutive scales (27), each of 8 m separated by 3 mm. from neighbouring scales. In any one sc

the second and sixth divisions are doubly numbered, so that up to seven whole turns of a given drum-nut can be recorded when the latter is carried in the appropriate direction past the scale, by the micrometer screw, from either of these two divisions as initial zero. The support is so placed that the edge mentioned above is normal to the eyes of an operator: it is on the side of the micrometer screw remote from the brakes to avoid shadows cast by its edge upon the graduations of the drum-nuts.

The large brass frame (7) consists of a rectangular plate (28), with a wide central slot (29) in the direction of its length, which supports a small frame (8) in suitable guides (38). This large frame hangs from the micrometer screw by means of two brass plates (30) and bears on the base plate through a thin narrow strip of brass (31) attached below the long edge of the frame remote from the screw. The bearings in the connecting plates (30) are unthreaded, as are the parts of the micrometer screw which revolve in them. The bearing in the plate nearest the turning-head is attached to the screw through a small accurately made ball-race (32). The other plate receives a plane spindle (33), turned down on the end of the micrometer screw, and is retained between the head of a screw (34) in the end of this spindle and the full diameter of the micrometer screw. This combination of thrust-bearing and ball-bearing minimizes 'play' parallel to the screw which ball-races in *both* plate-bearings might make possible. The brass strip (31) beneath the frame constitutes a flat bearing on which the frame slides over the base-plate whenever the micrometer screw is revolved. In view of this attachment, the frame and micrometer screw are always translated together. The frame cannot *revolve* with the screw, however, on account of a relieved phosphor-bronze spring (19), fixed to the base-plate, which presses against a bevel (35) on the edge of the frame immediately above the sliding bearing. A wider bevel (36) on the same edge of the frame carries an engraved line (37), used during the process of centering the instrument on a microscope stage.

The small rectangular brass frame (8) on the large frame (7) is designed to carry the specimen for analysis. It slides parallel to the plane, but at right angles to the direction of motion of the large frame, between bevelled guides (38) of solid brass. The latter were adopted for the sake of accuracy, after a combination of solid guide and spring guide was found to prevent exact parallel motion of the frame. Different rectangular depressions (39, 40, 41) in the frame

accommodate English object-slides of dimensions 3 by 1 and 2 b
1 inches, and Continental slides of dimensions 28 by 48 mm. An
of these slides is retained in position by two small phosphor-bronz
clips (42) attached to the frame beneath short milled columns (4
which are provided with milled brass buttons (44) on their free en
to facilitate adjustment of the clips. Traction or pressure with th
thumbs on these milled columns serves to move the frame, and th
amount of its motion can be measured, to 0·1 mm., by means
the vernier (45) on one of the short sides, in conjunction with
millimetre scale (46) on the contiguous guide. An engraved arrow (4
indicates the particular graduation of the latter opposite which th
zero-graduation of the vernier must be set when centering th
instrument on a microscope stage

(*c*) *Operation.*—A suitably prepared specimen is examined und
the microscope at a low magnification; one to six different kin
of constituents are chosen for measurement, and an approxima
estimate of their relative proportions is made by eye.

The instrument is set for centering on the microscope stage b
(*a*) rotating the micrometer screw until the line '37' engraved acro
the bevel '35' on the large frame is collinear with the line '49'
the base plate; (*b*) sliding the small frame, in its guides, until t
zero-graduation on its vernier coincides with the graduation on t
main guide-scale marked by the engraved arrow '48'; and (*c*) i
serting the 3×1 inches glass centering slide, bearing its engrav
cross (fig. 1), in the frame under the spring clips with its corre
face uppermost and its appropriate end adjacent to the vernier.

The instrument is placed on the stage with the micrometer scre
left-and-right, and the turning-head (20, 21) on the right of t
observer, after which the attachment-jaws (12) are drawn into co
tact with the edge of the axial hole (9) in the stage by means of t
small box-spanner. The objective is focused on the engraved cr
of the centering slide and the positions of the jaws (12) adjust
until, on rotating the stage through 360°, the image of the centre
the cross remains coincident with the image of the intersection of t
cross-wires in the microscope eyepiece. When this is achieve
the geometric axis of the hole in the base plate of the instrument
collinear with the optic axis of the microscope. The microme
screw is then traversed towards the right until it reaches an extre
position, when the centering slide is replaced by the specimen unc
consideration, care being taken to see that the object-slide of t

specimen falls into a depression in the frame matching its dimensions. Here it is convenient to lock the revolving stage if a clamp is provided.

To each constituent is allocated one or more drum-nuts for recording purposes. The exact form of the allocation depends upon the relative abundance of the several constituents, as estimated during the initial examination of the specimen. The drum-nuts are distinguished by the numbers on the buttons (25) of their respective brake-keys. Each of these drum-nuts is set with the graduation opposite its red zero-dot parallel to the nearest edge of the transverse scale-support (26), and its left-hand edge opposite the right-hand zero of its appropriate 8 mm. scale. This is done by holding down its brake-key with the left thumb, rotating the milled flange (22) of the nut with a convenient finger of the right hand, and reclamping the nut by releasing the key once more.

To choose an initial traverse line the small frame (8) is moved in its guides (38) until a suitable part of the specimen overlies that diameter of the centre hole in the base plate which is parallel to the micrometer screw. If the separation of traverse lines is determined by the scale (46) and vernier (45), it is convenient to make this initial line coincident with either a particular millimetre graduation, or the tenth of a millimetre nearest to it on the scale. The instrument is now prepared for measurement, and the process of recording is as follows.

The micrometer screw is revolved with the right hand by means of the outer knurled rim (20) of the turning-head, so that it travels from right to left through not only the threaded bearings of its main supports, but also those of the drum-nuts, carrying with it the appended frames (7, 8). During this revolution of the screw all the drum-nuts remain *stationary*, on account of their spring brakes.

Let A, B, C, D, E, and F represent six different kinds of constituents, and $a_1, a_2, \ldots a_n$ the individual particles of kind A and $f_1, f_2, \ldots f_n$ individual particles of kind F. Then immediately the image of the nearer boundary of a_1 in the line of the horizontal cross-wire becomes tangential to the image of the vertical cross-wire at the intersection of the cross-wires, the key of the drum-nut recording intercepts of particles of A is depressed and held down by the left thumb. Soon the continued travel of the micrometer screw brings the image of the farther boundary of a_1 tangential with the same cross-wire at the same point, when the key is released and reclamps the drum-nut

instantly. It will be observed that, during the time for which the nut was unclamped, and therefore revolving with the screw,[1] it moved parallel to the line of traverse through a distance equal to the intercept of a_1 on the line of traverse, the latter being marked by the image of the horizontal cross-wire in any given field of view. This process is repeated for grains $a_1 \ldots a_n$, as each passes the image of the vertical cross-wire, and the same simple operation is repeated for grains $b_1, b_2, \ldots f_1, f_2, \ldots$ as they appear, irrespective of their order of appearance, using the appropriate drum-keys in each case.

The normal maximum motion of any one of the drum-nuts from either of its zero positions is intended to be 6 mm. However, in case an operator causes a nut to overstep the zero of its transverse scale at the end of a traverse, an extra millimetre has been added at both ends of each transverse scale so that any nut can move a part, or all, of a seventh millimetre, provided that the next drum-nut in the direction of motion of the screw has travelled from its initial position by at least this distance. If, towards the end of a traverse, it is found that all the intercepts of a given kind of constituent cannot be recorded on a particular nut, and the other five nuts are in use, this particular nut can be returned to its initial zero with the finger-tip, as described above, after completing either 6 mm. or 7 mm. of travel, and recording can be resumed immediately the operation has been noted by means of some convenient symbol, such as an asterisk.

When the micrometer screw reaches its extreme left-hand position after travelling 25 mm., the integrated intercepts of constituents A, B, C, ... F are given immediately in millimetres, tenths and hundredths of a millimetre by the whole turns and fractions of a turn through which their appropriate drum-nuts have moved from initial positions. These readings are recorded on a sheet ruled as follows (p. 591), assuming that the second method of traversing described on the opposite page is adopted.

A new traverse line is chosen by moving the small frame (8) at right angles to the first line of traverse, either by an amount equal to one 'field width' or by a definite fraction of a millimetre determined with reference to the scale (46) and vernier (45). Before recording along this line the instrument must be set in one of two

[1] There is no significant slip between the nuts and the screw on account of the fact that the mass of each nut is disposed symmetrically about the screw its bearing is sprung on the screw, and is full of viscous lubricant.

ways. Either the requisite number of drum-nuts must be released, spun, and clamped with their left-hand edges opposite the *left-hand* zeros of their respective transverse scales, or the micrometer screw must be returned to its extreme *right-hand* position and the drum-nuts set once more with their left-hand edges opposite the *right-hand*

Traverse Symbol.	Drum-nut Number						Effective Traverse mm.	Notes.
	1	2	3	4	5	6		
A								
B								
C								
Y								
Z								
Total								
Per cent.								

zeros on their transverse scales. If the first method is adopted, recording is carried out while the micrometer screw is moved from left to right by the turning-head, and the alternative graduation-numbers on the drum-nut and transverse scales are used. This method is more rapid than the second method, since the drum-nuts will tend to be close to, or opposite, the left-hand ends of their transverse scales, after the first traverse, but in making readings it must be remembered that the alternative numbering must be employed. The second method consists in revolving the micrometer screw back to the right-hand extreme of its motion by means of the smaller knurled surface (21) on the turning-head, after which each drum-nut is set with its left-hand edge opposite the right-hand zero of its appropriate transverse scale. Recording is then carried out while the micrometer screw is moved from right to left along the screw line. This method has the merit that the same cycle of major operations is carried out in the same order for every traverse, and

only one set of numbers is concerned throughout. However, tim is spent in returning the screw to the right-hand end of its travers and in many cases the drum-nuts concerned must be moved throug a greater distance during resetting than is the case when the fir method is adopted.

In the above manner the whole of a thin-section, or other spec men, of normal size can be explored and measured. If it is necessa to make determinations along traverse lines at 90°, or any oth angle, to the first set, in the plane of the specimen, then either th specimen is remounted on its slide, or transferred to and reorient on a new slide, or one end of the given slide is cut off to preve its interference with the drum-nuts, and the part bearing the specim is attached to the upper surface of the small frame (8) by means dental wax or plasticine.

(*d*) *Utility.*—The chief value of the instrument lies in its abili to save time and energy otherwise spent in recording and addi many small measurements. Further, it diminishes the eye-stra involved in focusing the microscope-image and particular colum of a record-sheet alternately. For these reasons it tends to impro the speed and accuracy with which results are obtained, even skilled hands. It is believed that the instrument will be of serv for training students in the technique of micrometric analysis.

In petrography this micrometer has several well-known appli tions, chief among which are determinations of relative proportio of transparent or translucent minerals in many types of crystall rocks or artificially prepared crystalline silicates, as well as of clusions in natural and artificial minerals. From the volume-co positions which these data yield, weight-compositions and b chemical compositions can be derived, in certain cases, if represen tive figures for the specific gravities and chemical compositions the constituents are known. It is valuable also in finding the ra between glass and crystals in both natural glass-bearing rocks a those partly crystallized glasses of analogous composition wh have been prepared in laboratory furnaces, commercial gas furna or blast furnaces. The instrument can be used with equal succ for quantitative studies of opaque petrographic specimens, includ polished fragments of rocks, metallic ores [13], and meteorites. should be of service also in the quantitative examination of oolo and similar sediments.

In economic geology it promises to be of assistance for determin

the compositions of metalliferous minerals [13, 15, 16], natural solid fuels, refractories, building stones, and road-metals [17]. There would seem to be some applications for it in metric palaeontography, especially in such connexions as the quantitative study of microspores from coals, by the methods of A. Raistrick and J. Simpson [18], and similar palaeobotanical investigations.

For numerical analyses of mounts of detrital sediments, crushed rocks, diatomaceous or foraminiferal earths, globigerina or radiolarian oozes, spicule-rich beds, or separated microspores, the instrument can be employed as a simple mechanical stage, in conjunction with a counting device such as that introduced by C. J. C. Ewing in 1931 [19], or one developed recently by the author. In counting up to a hundred individuals of not more than six species of mounted particles along any one traverse, this micrometer can be employed without an extra tally by moving the appropriate drum-nuts one division per particle and reading the total number of particles of each kind at the end of each traverse. The arithmetic mean of diameters of one to six species of mineral-grain, or similar object, can be found conveniently from figures obtained by summing the diameters of a suitable number of each type on the micrometer, and enumerating individuals simultaneously with either of the above simple counting devices.

Since the validity of micrometric analysis by the Delesse-Rosiwal method has been tried and established, there seems to be some justification for the plea voiced by H. L. Alling [20] that more modal rock-data, obtained in this manner, would be of value, especially in relation to the body of normative data now available. It is hoped that this instrument will play its part in facilitating the collection of any such new modal information.

The author is deeply indebted to his father, Mr. J. A. W. Dollar, for financial assistance, and to Prof. C. E. Tilley for facilities in the workshop of the Department of Mineralogy and Petrology, University of Cambridge, during early stages in the development of the instrument. To Mr. A. N. Lanham, Chief Assistant in the above Department, the author would express his thanks for practical suggestions, and to Messrs. S. J. Stubbens, J. N. Stubbens, and E. S. Marsh, of Unicam Instruments, Ltd., Cambridge, he is equally grateful for unfailing patience and help in the construction and modification of experimental models.

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14. F. E. Thackwell, Econ. Geol., 1933, vol. 28, pp. 178–182.
15. R. E. Head and M. Slavin, U.S. Bureau of Mines, 1930, Tech. Pub. 10
16. R. E. Head, A. L. Crawford, F. E. Thackwell, and G. Burgener, U
Bureau of Mines, 1932, Tech. Pub. 533; ibid., 1934, Rep. of Investig. 3236.
17. B. Knight, Road aggregates, London, 1935, pp. 235–236.
18. A. Raistrick and J. Simpson, Trans. Inst. Mining Eng. London, 1932–19
vol. 85, pp. 225–235.
19. C. J. C. Ewing, Geol. Mag., 1931, vol. 68, pp. 136–140.
20. H. L. Alling, Interpretative petrology of the igneous rocks. New Y
and London, 1936, p. 312.

A Universal ore-polishing machine.

(With Plate XXI.)

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[Read March 11, 1937.]

AVAILABLE methods of grinding and polishing ore-minerals, in preparation for their examination with the ore-microscope in reflected light, fall into two categories. The more usual procedure, adapted from the corresponding methods in metallography, involves the use of high-speed laps faced with soft materials and supplied with relatively large quantities of abrasive mixed with water.[1] The advantages of this method are its rapidity (about ten minutes will usually suffice for the whole series of processes), the possibility of using unmounted chips, and the simplicity of the necessary equipment. Amongst its chief disadvantages are the high relief developed between hard and soft minerals in the same specimen and the dirtiness of the process owing to the large amounts of wet sludge produced.

A different kind of process was developed at Harvard University,[2] which dispenses with the use of coarse abrasives and of soft facings to the laps. Instead of a chip, a surface is cut with a diamond saw, and the laps are faced with copper or lead. The disadvantages include the necessity of mounting every specimen, the much greater time involved by the whole process, and the more elaborate apparatus. The advantages, however, to a large extent outweigh these drawbacks; the surfaces prepared are vastly superior for microscopic study, especially in the lack of relief; the mounted specimens are convenient to handle, examine, and store, and are practically indestructible, and the whole process is much cleaner owing to the very small amounts of abrasive employed and to the use of oil instead of

[1] M. N. Short, Bull. U.S. Geol. Survey, 1931, no. 825, pp. 10–17. H. Schneiderhan and P. Ramdohr, Lehrbuch der Erzmikroskopie, 1934, vol. 1, pp. 68–84.

[2] J. W. Vanderwilt, Econ. Geol., 1928, vol. 23, p. 292. L. C. Graton, Amer. ,, 1937, vol. 22, p. 491.

water as a lubricant. Moreover, the polishing is to a large extent automatic, so that in a small laboratory the machines can be left running with a minimum of attention on the part of the operator.

In building the machine to be described the main consideration was one of economy, both in initial outlay and in flexibility of use of the complete equipment—the one outfit was required to serve for any kind of polishing process likely to be undertaken. (It may be observed that even material transparent in thin section may sometimes be advantageously examined in polished and etched surfaces considerable use of this method has lately been made in the study of Portland cement clinker.[1]) The general arrangement is shown in pl. xxi, fig. 1.

Cloth-faced laps for rapid polishing require to be driven at speeds of the order of 1000 r.p.m., whilst the metal laps must revolve at about one-tenth of this speed. A $\frac{3}{4}$ h.p. 3-phase motor, running at 700 r.p.m., is fitted with a double pulley of 3 and 6 inches diameter. The drive is taken to a similar double pulley mounted on the input shaft of a motor-bicycle gear-box, and the output is taken from another 3-inch pulley over jockeys on the bench to a 4-inch pulley beneath the left-hand lap. On a direct drive, a lap speed in excess of 1000 r.p.m. is thus available, whilst reduction by changing the belt in conjunction with a 3 to 1 ratio in the box gives a lap speed of less than 100 r.p.m. A number of intermediate speeds can be obtained by different arrangements of the belt in combination with intermediate gear ratios. The general design of each lap is readily understood from text-fig. 1. The $\frac{7}{8}$-inch steel spindle runs in two ball-races, the upper of which is a combination journal- and thrust bearing; the laps, $7\frac{1}{2}$ inches diameter, are held by a $\frac{7}{16}$-inch bolt running through the spindle and furnished below the driving pulley with a large knurled knob. This arrangement has been found in practice to be much more convenient than any of the usual cone bearings and similar devices—the laps are firmly held, yet instantly detachable. The pan is an aluminium casting 9 inches diameter bolted to a $\frac{5}{8}$-inch steel plate, and is furnished with an aluminium guard-ring and a drain for the removal of sludge. A brass collar brought up just to clear the lower surface of the lap affords adequate protection to the bearings.

[1] B. Tavasci, Giornale di Chim. Indust. ed Appl., 1934, vol. 16, pp. 538–5[illegible] (Abstract in Zeiss Nachrichten, 1936, 2 Folge, Heft 1, p. 32.) H. Insley, Journal Research Nat. Bureau of Standards, U.S.A., 1936, vol. 17, pp. 353–361.

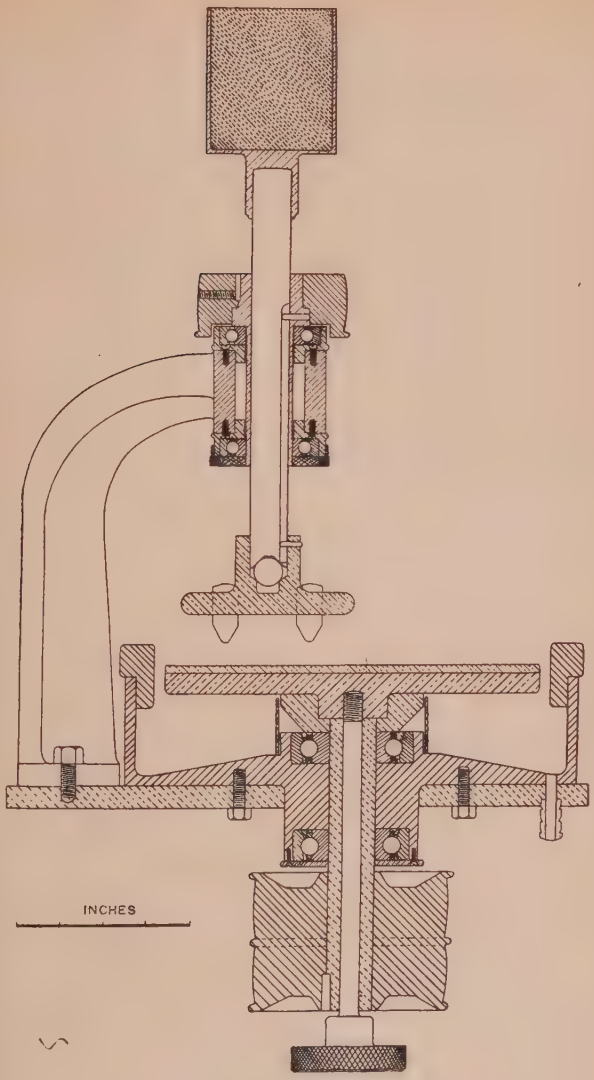


Fig. 1. Universal ore-polishing machine. Part-sectional elevation of lap and head for automatic polishing.

The heads for automatic polishing are carried on cast aluminium brackets bolted to the steel plates. A ¾-inch steel shaft is keyed to slide in a steel sleeve to which the driving pulley is attached, and ball-races are again used here. After some experimenting with different methods of holding and driving the specimens, it was found that the best results were obtained with a simple arrangement closely resembling that originally described by Vanderwilt. A brass plate carries three driving pins, adjustable to the heights of the individual specimens, and these rest in conical depressions moulded directly in the backs of the mounts. The lower end of the driving shaft rests on a steel ball above this plate, the drive being effected through a second key. The specimens are thus left free to bed individually on the laps and also to revolve about their own axes, and completely satisfactory results have been obtained without the added complications necessary to impart a positive axial spin to each specimen. The sliding shaft is loaded by lead weights fitted over its upper end; an added weight of about 12 lb. has proved generally satisfactory. The heads are driven from an intermediate shaft bolted to the wall which is itself driven from a pulley beneath the right-hand lap; a belt beneath the table conveys the drive from one head to the other. The diameters of the pulleys are such as to impart a final speed to the heads of about twice that of the laps, the rotations of the head and lap in opposite senses being secured by twisting the intermediate belt. Driving throughout is by 1-inch flat belt, and to avoid unnecessary vibration all the belts are sewn and fitted with tensioning pressers contrived from ball-bearing bicycle hubs.

Four laps are in general use, one faced with copper (thick sheet copper soldered to the gun-metal casting) and three with lead (cast directly in the lap tinned to receive it). On the copper lap graded alumina averaging 0·02 mm. diameter is used, on the first lead lap 0·01 mm. alumina, and on the second lead lap prepared Dujardin alumina. The third lead lap is used for magnesia or rouge, though it has frequently been found possible to dispense with this final stage, the specimens coming off the second lead lap with a complete and satisfactory polish. The method of charging the laps and the use of the oil lubricant have been fully described by Vanderwilt. The graded alumina is prepared from the commercial product by grinding and subsequent elutriation in a series of syphons;[1] experience has shown that the precise grade of abrasive used on the first lead lap

[1] J. W. Vanderwilt, Econ. Geol., 1929, vol. 24, p. 853.

is specially important; if too coarse, the subsequent polishing is rendered unduly difficult, whereas too fine an abrasive at this stage will begin to polish projecting parts of the surface without removing the deeper pits left after treatment on the copper lap. The motor which drives the stirrer of the elutriator is conveniently fitted with a light lap faced with billiard cloth and running directly at 1400 r.p.m., for use in quick polishing by hand.

The mounts are $1\frac{1}{2}$ inches diameter, and are moulded in a small electrically heated press, the plunger of which is turned with a conical projection to form the depression in the back of the specimen in which the driving pin rests. The moulding material employed is Black Rhodoid Powder, 4016 R.K.B.,[1] a plastic material made from cellulose acetate. The press is turned in brass throughout, and has given entirely satisfactory results, thus avoiding the more difficult mechanical work involved in grinding and case-hardening steel.[2] It is wound with about 30 ohms of resistance wire laid between layers of asbestos paper, and passes 3·5 amps. when run off a 200-volt main through an intermediate variable resistance. Pl. xxi, figs. 2 and 3, show the assembled press and the component parts. In use, the cut chip is placed face down on the brass base of the press and the body of the press is fitted above. A measured amount of the moulding material is poured in, and lightly tamped down; the plunger is inserted and the press is lightly screwed home until resistance is felt. The current is then switched on for five minutes, after which the press is screwed further until a strong resistance is again felt. The current is cut off and the whole apparatus allowed to become quite cold. The specimen can then be ejected without difficulty by mounting the press on an auxiliary ring;[3] a slight smearing of talc on the inside surfaces before each mount is made makes ejection still easier.[4] If the chip is friable or porous it is impregnated with Bakelite resin R. 0014[5] and cured before moulding.

It is a pleasure to acknowledge my indebtedness on many points of design to Mr. A. N. Lanham, who is also entirely responsible for the construction of the machine.

[1] Supplied by Messrs. May & Baker Ltd., Dagenham, London.
[2] P. Krieger and P. H. Bird, Econ. Geol., 1932, vol. 27, p. 675.
[3] H. C. Fuller, Econ. Geol., 1933, vol. 28, p. 393.
[4] P. B. Myers, Econ. Geol., 1934, vol. 29, p. 502.
[5] Supplied by Bakelite Ltd., Tyseley, Birmingham.

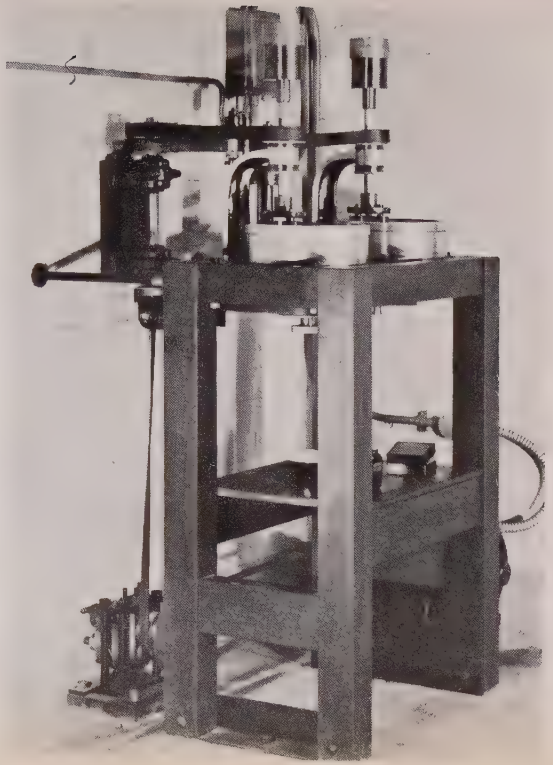
Explanation of Plate XXI.

A Universal ore-polishing machine.

Fig. 1. General view of the machine. The motor is on the floor behind the table, and the gear-box on the left.

Fig. 2. The mounting press.

Fig. 3. The parts of the press, showing the electrically heated body, plunger with conical projection, plunger cap, a mounted specimen, base of press, and ejecting ring.



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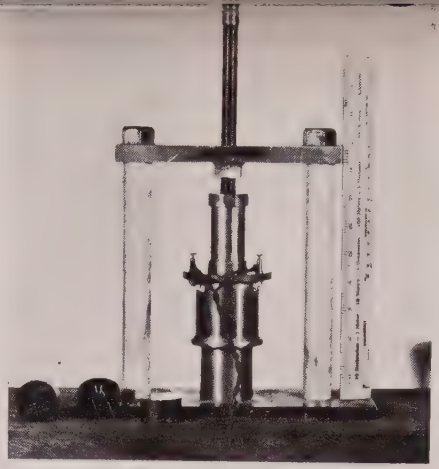
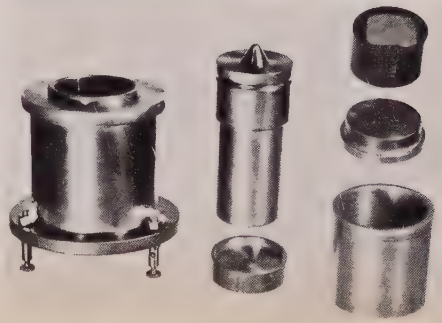


2



3

F. C. Phillips : Universal ore-polishing machine

Fourteenth list of new mineral names.[1]

By L. J. Spencer, C.B.E., M.A., Sc.D., F.R.S.
Formerly Keeper of Minerals in the British Museum.

[Communicated June 24, 1937.]

Ahlfeldite. R. Herzenberg, 1935. Zentr. Min., Abt. A, 1935, pp. 189, 279 (Ahlfeldit). Nickel selenate (or selenite) occurring as a reddish alteration product of blockite (q.v.), from Colquechaca, Bolivia. Perhaps identical with cobaltomenite. Named after Dr. Friedrich Ahlfeld, of Marburg, Germany. [M.A. **6**–147.]

Aidyrlite. M. N. Godlevsky, 1934. Mém. Soc. Russ. Min., ser. 2, vol. 63, p. 338 (Айдырлит), p. 344 (Aidyrlit). Hydrated silicate of aluminium and nickel, $2NiO.2Al_2O_3.3SiO_2.7\frac{1}{2}H_2O$, as compact turquoise-blue masses, from the river Aidyrly (p. Айдырлы), Urals. Named from locality. [M.A. **6**–150.]

Aikinite. R. P. Greg and W. G. Lettsom, Mineralogy of Great Britain and Ireland, 1858, p. 354. Pseudomorph of wolframite after scheelite from Cornwall, named by A. Lévy [but not found in any of his publications]. Named after Arthur Aikin (1773–1854). Not the aikinite of E. J. Chapman, 1843.

Alumochromite. A. G. Betekhtin, 1934. Ann. Inst. Mines, Leningrade, vol. 8, p. 38 (алюмохромит), p. 63 (Alumchromit). A member of the spinel group with the composition $Fe(Cr,Al)_2O_4$. Other hypothetical members of the group are named Magnoferrichromite, $(Fe,Mg)(Cr,Fe)_2O_4$ (магноферрихромит, Magnoferrichromit); Ferrichromspinel, $Mg(Cr,Al,Fe)_2O_4$ (феррихромшпинель, Ferrichromspinel); and Ferrichrompicotite, $(Fe,Mg)(Cr,Al,Fe)_2O_4$ (феррихромпикотит, Ferrichrompikotit). Several other names of this type for the spinel group are given by A. K. Boldyrev, Kurs opisatelnoi mineralogii, Leningrad, 1935, part 3, p. 115 (*see* Cobaltochrompicotite).

[1] Previous lists of this series have been given every three years at the ends of vols. 11–23 (1897–1934) of this Magazine. The 1506 names in the first ten lists were included in one alphabetical arrangement in the General Index (1926) to vols. 11–20 (1895–1925). References to 'Mineralogical Abstracts' are given in this form [M.A. **6**–147].

Alumopharmacosiderite. G. Hägele and F. Machatschki, 1937 Fortschr. Min. Krist. Petr., vol. 21, p. 77 (Alumopharmakosiderit) Artificially prepared cubic crystals $Al_3(AsO_4)_2(OH)_3.5H_2O$, or perhap $Al_5As_3O_{12}(OH)_6.6H_2O$, analogous to pharmacosiderite with aluminiun in place of iron.

Anthracene. R. Rost, 1935. Věda Přírodní, Praha, vol. 16 p. 204 (antracen). An organic compound ($C_{14}H_{10}$) formed by th burning of pyritous shale in Bohemia. [M.A. **6**–357.]

Arsenostibite. P. Quensel, 1937. Geol. För. Förh. Stockholm vol. 59, p. 148 (arsenostibite). Variant of arsenstibite (— Adan 1869) for an amorphous alteration product of allemontite consistin of hydrated oxides of arsenic and antimony. [M.A. **6**–487.]

Arsentsumebite. Bull. Soc. Franç. Min., 1935, vol. 58, p. (arsentsumébite). A variety of tsumebite (6th List) containing som arsenate in place of phosphate of lead and copper, from Tsumeb South-West Africa.

Astridite. H. W. V. Willems, 1934. De Ingenieur in Nede landsch-Indië, vol. 1, part 4 (Mijnbouw en Geologie), p. 120 (Astr diet). An ornamental stone consisting mainly of chromojadeite fro New Guinea. Named after Astrid (1905–1935), Queen of Belgiun [M.A. **6**–502.]

Attapulgite. J. de Lapparent, 1935. Compt. Rend. Acad. Sc Paris, 1935, vol. 201, p. 483; 1936, vol. 202, p. 1728; 1936, vol. 20 pp. 482, 596. A variety of fuller's earth containing alumina and ma nesia, $x[9SiO_2.6(Mg,Fe'',Ca)O.12H_2O] + y[9SiO_2.2(Al,Fe''')_2O_3.12H_2O]$ from Attapulgus, Georgia, U.S.A. P. F. Kerr (Amer. Min., 193 vol. 22, p. 534) identifies it with montmorillonite. [M.A. **6**–15 346, 413.]

Aurosmirid. O. E. Zvyagintzev, 1934. Doklady Akad. Nau CCCP (Compt. Rend. Acad. Sci. URSS), vol. 4, p. 178 (ауросмирид p. 179 (Aurosmirid). Solid solution of gold and osmium in cub iridium (as distinct from a solid solution of iridium, &c., in hexagon osmium). Found as silver-white grains in residues of Urali platinum insoluble in aqua regia. A contraction of aurum-osmiu iridium. [M.A. **6**–51.]

Austinite. L. W. Staples, 1935. Amer. Min., vol. 20, pp. 11 199. Basic arsenate of calcium and zinc, $CaZn(OH)AsO_4$, as colou

less bisphenoidal orthorhombic crystals, from Utah. Identical with brickerite (13th List), F. Ahlfeld and R. Mosebach, Zentr. Min., Abt. A, 1936, p. 289. Not to be confused with austenite (F. Osmond, 1895), a constituent of manufactured steel. Named after Professor Austin Flint Rogers (1877–), of Stanford University, California. [M.A. **6**–53, 345, 384.]

Bacalite. J. D. Buddhue, 1935. Rocks and Minerals, Peekskill, N.Y., vol. 10, p. 171. A variety of amber from Baja (Lower) California, Mexico. Named from the locality in a contracted form. (Not to be confused with the artificial product bakelite.) [M.A. **6**–503.]

Beiyinite. T. L. Ho, 1935. Bull. Geol. Soc. China, vol. 14, p. 279 (Beiyinite). An undetermined mineral presumed to contain rare-earths (La, Ce, Yt, Er) as minute grains (tetragonal?) in fluorite from Beiyin Obo, Inner Mongolia. With oborite (q.v.), named from the locality. [M.A. **6**–151.]

Bermanite. C. S. Hurlbut, 1936. Amer. Min., vol. 21, p. 657. Hydrated basic phosphate of manganese, &c. $(Mn,Mg)''_5(Mn,Fe)''_8(PO_4)_8(OH)_{10}.15H_2O$, as minute reddish-brown orthorhombic crystals in triplite from Arizona. Named after Dr. Harry Berman of Harvard University, Cambridge, Massachusetts. [M.A. **6**–442.]

Bismoclite. E. D. Mountain, 1935. Min. Mag., vol. 24, p. 59. Bismuth oxychloride, pale grey, compact (tetragonal), from South Africa. Named from the chemical composition BiOCl.

Blockite. R. Herzenberg, 1935. Zentr. Min., Abt. A, 1935, 189; R. Herzenberg and F. Ahlfeld, ibid., p. 277 (Blockit). Nickel and copper selenide $(Ni,Cu)Se_2$, as shelly masses, from Colquechaca, Bolivia. F. A. Bannister and M. H. Hey (Amer. Min., 1937, vol. 22, p. 319) identify it with penroseite (11th List). Named after the mining engineer, Hans Block, who collected the material. [M.A. 6–147, 490.]

Bokseputite. E. D. Mountain, 1935. Min. Mag., vol. 24, p. 62. Carbonate of lead and bismuth, $6PbO.Bi_2O_3.3CO_2$, pale yellow, compact. Named from the locality, Boksput farm, Gordonia, South Africa.

Boodtite. L. De Leenheer, 1936. Natuurwet. Tijdschr. Gent, vol. 18, p. 77 (boodtiet). Hydrated oxide of cobalt, copper, and iron, $5Co_2O_3.CuO.Fe_2O_3.11H_2O$, as friable grey-black masses, from Katanga. Named after Anselm Boëthius de Boodt (1550–1634) of

Bruges, author of 'Gemmarum et lapidum historia' (1609). [M.A. **6**-343.]

Brandãosite. A. Mário de Jesus, [1936]. Com. Serv. Geol. Portugal, vol. 19 (for 1933), p. 132 (Brandãosite). An almandine-spessartine with a formula, $4RO.R_2O_3.4SiO_2$, different from that of garnet. From Mangualde, Portugal. Named after the Portuguese crystallographer, Vicente de Souza Brandão (1863–1916). [M.A. **6**-441.]

Broggite. G. A. Fester and J. Cruellas, 1935. Bol. Soc. Geol. Peru, vol. 7, p. 14 (Broggita). A variety of asphaltum from Peru. Named after Jorge Alberto Broggi, Inspector-General of Mines in Peru. [M.A. **6**–443.]

Bungonite. I. Iwasa, 1877. [Gakugéisirin, no. 57.] Z. Harada, Journ. Fac. Sci. Hokkaido Univ., Sapporo, Ser. 4, 1936, vol. 3, p. 32 (Bungonit). An incorrectly determined mineral from Japan, afterwards (Z. Sasamoto, 1895) identified with kämmererite. Presumably named from the locality, Bungo, Japan.

Calcio-åkermanite. A. N. Winchell, Optical mineralogy, 2nd edit., New York, 1927, p. 267 (Calcium-akermanite). O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 71 (кальцио-акерманит, calcio-åkermanite). The hypothetical molecule $Ca_3Si_2O_7$, i.e. åkermanite with Mg replaced by Ca. [Cf. M.A. **2**–427.]

Calcio-olivine. O. M. Shubnikova and D. V. Yuferov, 1934, Spravochnik po novym mineralam, Leningrad, 1934, p. 67 (Кальцио-оливин), p. 163 (Calcio-olivin). Translation of Lime-olivine and Kalk-Olivin (11th List).

Calcio-spessartine. O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 66 (Кальцио-спессартит, Calc-spessartite), p. 163 index (Calcio-spessartite). Variant of calc-spessartite (11th List).

Calcium-melilite. A. N. Winchell, 1933. Optical mineralogy, 3rd edit., New York, 1933, p. 208 (Calcium-melilite). A hypothetical molecule, $Ca_3Al_2Si_4O_{14}$, to interpret the composition of mixed crystals of the melilite group.

Calcium-rinkite. I. D. Borneman-Starynkevich, 1935. Materials Geochem. Khibina tundra, Acad. Sci. USSR, pp. 48, 57, 65 (кальциевый

ринкит); P. N. Chirvinsky, ibid., pp. 82, 88 (Kalzium-Rinkit). Fluo-titano-silicate of calcium and sodium, $3CaTiO_3.10(Ca,Na_2,H_2)SiO_3.3CaF_2$, isomorphous with rinkite with calcium in place of cerium earths; from the Kola peninsula, Russia. Perhaps identical with hainite (J. Blumrich, 1893; 1st List; incorrectly spelt as Gainit, гаинит). [M.A. **6**–343.]

Calcotephroite. C. Palache, 1935. Prof. Paper U.S. Geol. Survey, no. 180, p. 80. Local name for what appears to be an impure variety of glaucochroite ($CaMnSiO_4$).

Capreite. R. Bellini, 1922. Boll. Soc. Geol. Ital., vol. 40 (for 1921), p. 228 (Capreite). A black encrustation on the walls of a limestone cave on the sea-shore of the island of Capri, Italy. A fetid calcite similar to pelagosite. Named from the locality.

Carbocer. I. D. Borneman-Starynkevich, 1933. Khibina Apatite, Leningrad, 1933, vol. 6, p. 272 (Карбоцер, Carbocer). O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 157. A carbonaceous mineral containing 8·2 % of rare-earths; burns with loss on ignition 74·36 %. Occurs in kondrikovite from the Kola peninsula, Russia. Named from carbon and cerium. [M.A. **6**–342.]

Carburan. A. N. Labuntzov, 1934. O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 157 (Карбуран, Carburan). P. K. Grigoriev, Trans. Geol. Prosp. Inst. USSR, 1935, no. 37, p. 29 (карбуран). A carbonaceous mineral containing C 60·96, H_2O 28·93, ash 9·51 % (the ash contains UO_3 54·20, PbO 17·01, Fe_2O_3 6·01 %), occurring with uraninite in pegmatite in Karelia, Russia. Related to thucholite (11th List). Named from carbon and uranium. [M.A. **6**–437.]

Cayeuxite. Z. Sujkowski, 1936. Arch. Min. Tow. Nauk. Warszaw. (Arch. Min. Soc. Sci. Varsovie), vol. 12, p. 122 (cayeuxyt), p. 138 (cayeuxite). Pyritic nodules rich in As, Sb, Ge, Mo, Ni, &c., from lower Cretaceous shales in the Carpathians. Named after Prof. Lucien Cayeux (1864–) of Paris. [M.A. **6**–344.]

Cerapatite. A. E. Fersman, 1926. Neues Jahrb. Min., Abt. A, Beil-Bd. 55, pp. 40, 45 (Cerapatit); Amer. Min., 1926, vol. 11, p. 293 (cerium-apatite). O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 109 (церапатит, cerapatite).

A variety of apatite containing 3·18 % of rare-earths (Ce_2O_3 1·33 from the Kola peninsula, Russia. [Cf. M.A. **2**–408, 409; **3**–23 **6**–233, 312.]

Chlopinite. *See* Khlopinite.

Chlor-amphibole. G. A. Krutov, 1936. *See* Dashkesanite.

Chrome-epidote. P. Eskola, 1933. Compt. Rend. Soc. Gé Finlande, 1933, no. 7, pp. 35, 38 (chrome epidote). Variant chromepidote (10th List) for tawmawite (5th List) or the compou $H_2Ca_4Cr_6Si_6O_{26}$. Varieties richer in aluminium are 'chrome clinoz site', and those richer in iron 'chrome pistazite'. [M.A. **6**–47.]

Chrome-tremolite. P. Eskola, 1933. Compt. Rend. Soc. Gé Finlande, 1933, no. 7, p. 31 (chrome-tremolite), p. 39 (chrome trem lite). Bull. Soc. Franç. Min., 1933, vol. 56, p. 188 (chromtrémolit Tremolite containing Cr_2O_3 1·61 %, from Outokumpu, Finlan [M.A. **6**–47.]

Chrome-vesuvian. S. M. Kurbatov, 1922. Bull. Acad. S Russie, 1922, ser. 6, vol. 16, p. 414; 1923, vol. 17, p. 115; 192 vol. 19, p. 482 (хромовый везувиан). C. Hintze, Handbuch d Mineralogie, Ergänzungsband, 1936, p. 116 (Chromvesuvian). Synony of chrome-idocrase (7th List). [M.A. **3**–354.]

Clarite. R. Potonié, 1924. Kohlenpetrographie, Berlin, p. (Clarit). Variant of clarain (8th List). Not the clarite of F. San berger, 1874. The names Durain, Fusain, and Vitrain (8th List) a similarly altered to Durit, Fusit, and Vitrit. Several other variatio of these names are given by E. Stach, Lehrbuch der Kohlenpetr graphie, Berlin, 1935.

Clinoferrosilite. N. L. Bowen, 1935. Amer. Journ. Sci., ser. vol. 30, pp. 481, 492. N. F. M. Henry, Min. Mag., 1935–37, vol. 2 pp. 225, 528. A monoclinic pyroxene with the composition FeSiO ferrous metasilicate, found as minute crystals in the lithophysae obsidians. [M.A. **6**–261.]

Clino-triphylite. P. Quensel, 1937. Geol. För. Förh. Stockhol vol 59, p. 81 (clino-triphylite). A form of triphylite, Li(Fe,Mn)P with polysynthetic twinning and optical extinction suggesting dive gence from orthorhombic symmetry. [M.A. **6**–485.]

Clino-ungemachite. M. A. Peacock and M. C. Bandy, 1936. Amer. Min., 1936, vol. 21, no. 12, pt. 2, p. [2]; 1937, vol. 22, p. 207. Monoclinic (pseudo-rhombohedral) crystals closely related to ungemachite (q.v.). [M.A. **6**–443.]

Cobaltochrompicotite. A. K. Boldyrev, 1935. Kurs opisatelnoi mineralogii, Leningrad, part 3, p. 115 (Кобальтохромпикотит). A member of the spinel group containing cobalt, $(Mg,Fe,Co)(Cr,Al)_2O_4$ (?). Many other compound names are here given for the spinel group. *See* Alumochromite.

Cobalto-sphaerosiderite. R. Reissner, 1935. Zentr. Min., Abt: A, 1935, p. 173 (Cobalto-Sphärosiderit, Kobalt-Oligonspat). A peach-blossom-red rhombohedral carbonate containing $FeCO_3$ 40·48, $MnCO_3$ 19·11, $MgCO_3$ 21·06, $CoCO_3$ 14·44, $CaCO_3$ 4·34, $ZnCO_3$ 0·61%. [M.A. **6**–151.]

Colloid-calcite, &c. *See* Kolloid-calcite.

Coulsonite. J. A. Dunn, 1937. Mem. Geol. Surv. India, vol. 49, p. 21. J. A. Dunn and A. K. Dey, Trans. Mining Geol. Inst. India, 1937, vol. 31, p. 131. A vanadiferous iron ore assumed to have the composition $FeO.(Fe,V)_2O_3$. It occurs in magnetite from Bihar, India, and was first mentioned under the name vanado-magnetite (q.v.). Named after Dr. Arthur Lennox Coulson, of the Geological Survey of India. [M.A. **6**–489.]

Cuprolovchorrite or **Cuprovudyavrite.** P. N. Chirvinsky, 1935. Materials Geochem. Khibina tundra, Acad. Sci. USSR, p. 87 (медистый ловчоррит, медистый вудъяврит), p. 89 (Kupfferlovčorrit, Kupfferwudjavrit). An emerald-green amorphous mineral occurring with lovchorrite (11th List) and vudyavrite (q.v.) in the Kola peninsula, Russia. [M.A. **6**–343.]

Cuproplatinum. P. A. Wagner, 1929. The platinum deposits and mines of South Africa, p. 11. A variety of platinum containing 3–13% of copper, occurring as thin shells around grains of ferroplatinum from the Urals. It was first described as 'copper-bearing platinum' by A. N. Zavaritzky, Matér. Géol. gén. appl., Comité Géol., Leningrad, 1928, no. 108, p. 55 [M.A. **6**–365].

Cuprovanadinite. E. M. Yanishevsky, 1931. Trans. Geol. Prospecting Service USSR, fasc. 109, p. 19 (купрованадинит). A

variety of vanadinite containing copper (CuO 1·55%) from Kazakhstan. Not the cuprovanadite (= chileite) of — Adam, 1869.

Dakeite. E. S. Larsen, 1937. Mineralogist, Portland, Oregon, vol. 5, no. 2, p. 7. E. S. Larsen and F. A. Gonyer, Amer. Min., 1937, vol. 22, p. 561. A complex mineral $3CaCO_3.Na_2SO_4.UO_3.10H_2O$, occurring as green-yellow nodules in surface efflorescences of gypsum in Wyoming. Named after Dr. Henry C. Dake, of Portland, Oregon. [M.A. **6**–488.]

Dashkesanite. G. A. Krūtov, 1936. Bull. Acad. Sci. URSS, Cl. Sci. Mat. Nat., Sér. Géol., p. 341 (дашкесанит, хлорсдержащий амфибол), p. 371 (dashkessanite, chlorine amphibole). A chlorine amphibole of the hastingsite group, containing Cl 7·24%. Named from the locality, Dashkesan, Transcaucasia. [M.A. **6**–438.]

Earlandite. F. A. Bannister, 1936. Discovery Reports, Cambridge, vol. 13, p. 67. Hydrated calcium citrate, $Ca_3(C_6H_5O_7)_2.4H_2O$, as small warty nodules in deep-sea deposits from the Weddell Sea, Antarctic. Named after Mr. Arthur Earland, of London, who isolated the material. [M.A. **6**–341.]

Eisenhypersthen. M. Saxén, 1925. *See* Iron-hypersthene.

Eisenstrigovit. Neues Jahrb. Min., Ref. I, 1936, p. 467. German translation of Iron-strigovite (q.v.).

Enelectrite. T. L. Walker, 1934. Univ. Toronto Studies, Geol. Ser., no. 36, p. 11; Amer. Min., 1935, vol. 20, p. 195. Minute colourless monoclinic crystals, presumably a hydrocarbon, embedded in amber (*ἤλεκτρον*) from Manitoba. [M.A. **6**–52.]

Epileucite. A. N. Zavaritzky, 1934. Compt. Rend. Acad. Sc. URSS, 1934, vol. 3, p. 645 (эпилейцит), p. 650 (epileucite). Pseudomorphs of orthoclase and muscovite after leucite, in distinction from pseudoleucite (pseudomorphs of orthoclase and nepheline after leucite). [M.A. **6**–418.]

Epi-sericite. J. Jakob, 1933. Schweiz. Min. Petr. Mitt., vol. 13, p. 82 (Epi-Sericit). Sericite formed in the epi- (upper) zone of metamorphism of U. Grubenmann (1907).

Ermakite. P. L. Dravert, 1926. Bull. West Siberian Branch Russ. Geogr. Soc. (Изв. Зап.-Сиб. отд. Русс. Географ. Общ.), vol. 1, p. 137 (Ермакит, Ermakite). A brown waxy clay with the approx-

mate composition $(Al,Fe)_2O_3.3SiO_2.2H_2O$, from the banks of the Irtysh river near Omsk, Siberia. Named after Ermaka Timofeevicha (Ермака Тимофеевича), who met her death in this river in the year 1584.

Eutectoperthite, Eutecto-oranite. H. L. Alling, 1921. *See* Hypoperthite.

Feraxinite. A. N. Winchell, 1927. Elements of optical mineralogy, 2nd edit., New York, p. 254. A rather unnecessary contraction of ferroaxinite (5th List).

Ferri-beidellite. O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934 (ферри-бейделлит, ferri-, iron-, Eisen-beidellite). Translation of Iron-beidellite (11th List).

Ferrichrompicotite, Ferrichromspinel. A. G. Betekhtin, 1934. *See* Alumochromite.

Ferri-halloysite. N. E. Efremov, 1936. Mém. Soc. Russ. Min., ser. 2, vol. 65, p. 225 (ферри-галлуазит), p. 232 (ferri-halloysite). A variety of halloysite containing iron.

Ferri-paraluminite. P. P. Pilipenko, 1927. [Ученые Записки Саратов. Университета, Mem. Univ. Saratov, 1927, vol. 6, p. 171.] O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 149 (Железистый паралюминит, Ferriparaluminite, Eisenparaluminit), p. 164 ('Ferro-paraluminite'). Abstract in Neues Jahrb. Min., Ref. I, 1928, p. 298 (Eisenparaluminit). A variety of paraluminite containing iron (Fe_2O_3 13·39%), $2(Al,Fe)_2O_3.SO_3.15H_2O$; deposited as a greenish-grey slime (earthy when air-dried), together with paraluminite and aluminite, by springs from Cretaceous rocks near Saratov.

Ferri-sicklerite. P. Quensel, 1937. Geol. För. Förh. Stockholm, vol. 59, p. 85 (ferri-sicklerite). An intermediate member of the series triphylite–ferri-sicklerite–heterosite in which iron predominates over manganese, the parallel series in which manganese predominates being lithiophilite–sicklerite (Mn-sicklerite)–purpurite. [M.A. **6**–485.]

Ferro-åkermanite. O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 71 (феррокерманит, ferro-, iron-, Eisen-åkermanite). Translation of Eisenåkermanit (9th List) and Iron-åkermanite (10th List).

Ferro-chrysotile. F. V. Syromyatnikov, 1934. Bull. Soc. Nat Moscou, ser. 2, vol. 42 (Sect. Geol., vol. 12), p. 568 (феррo-хризотил) p. 574 (ferro-chrysotile). The molecule $H_4Fe_3Si_2O_9$ present in ferruginous chrysotile. [M.A. **6**–259.]

Ferrodolomite. A. N. Winchell, 1927. *See* Magnesiodolomite.

Fluor-amphibole. N. L. Bowen and J. F. Schairer, 1935. Amer Min., vol. 20, p. 543 (fluor-amphiboles). Artificial $F_2R''_7(Si_4O_{11})_2$ with fluorine replacing hydroxyl of hydroxy-amphibole $[(OH)_2R''_7(Si_4O_{11})_2$ $= H_2R''_7(SiO_3)_8]$. [M.A. **6**–353.]

Fluor-annite, Fluor-biotite, &c. D. P. Grigoriev, 1935. Mém Soc. Russ. Min., ser. 2, vol. 64, pp. 69, 70, 79. The following names are applied to magnesium-iron-micas:

Fluor-annite (фтор-аннит), $F_2KFe''_3(AlSi_3)O_{10}$.
Fluor-biotite (фтор-биотит), $F_2K(Mg,Fe'')_3(AlSi_3)O_{10}$.
Fluor-phlogopite (фтор-флогопит), $F_2KMg_3(AlSi_3)O_{10}$.
Fluor-siderophyllite (фтор-сидерофиллит), $F_2KFe''_3[(Al,Fe''')Si_3]O_{10}$.
Fluor-lepidomelane (фтор-лепидомелан), $F_2K(Mg,Fe'')_3[(Al,Fe''')Si_3]O_{10}$.
Fluor-meroxene (фтор-мероксен), $F_2KMg_3[(Al,Fe''')Si_3]O_{10}$.

Similarly, Hydroxyl-annite (гидроксил-аннит), $(OH)_2KFe''_3(AlSi_3)O_{10}$ Hydroxyl-biotite, Hydroxyl-phlogopite, Hydroxyl-siderophyllite Hydroxyl-lepidomelane, and Hydroxyl-meroxene, with $(OH)_2$ in place of F_2.

Fluorene. R. Rost, 1935. Věda Přírodní, Praha, vol. 16, p. 20 (fluoren). An organic compound ($C_{13}H_{10}$) formed by the burning o pyritous shale in Bohemia. [M.A. **6**–357.]

Gahnospinel. B. W. Anderson and C. J. Payne, 1937. Mir Mag., vol. 24, p. 554. A gem magnesium-zinc-spinel containin ZnO up to 18·2 %, approaching gahnite in composition.

Gainite. P. N. Chirvinsky, Materials Geochem. Khibina tundra Acad. Sci. USSR, 1935, p. 86 (гаинит), p. 88 (Gainit). Error fo hainite (J. Blumrich, 1893; 1st List), due to the transliteration int Russian and back again. *See* Calcium-rinkite.

Gokaite. T. Tomita, 1936. Journ. Shanghai Sci. Inst., sect. 2 vol. 2, p. 99 (gokaite). A clinohypersthene with small optic axia angle Named from the locality, Goka, Oki islands, Japan.

Goureite. A. Lacroix, 1934. Mém. Acad. Sci. Paris, vol. 61, p. 320 (gouréite). An undetermined mineral occurring as pale yellow, skeletal, optically uniaxial crystals in microgranite from Gouré (= Gure), west of Lake Chad, French West Africa. Named from the locality. The mineral was first mentioned, but not named, in Compt. Rend. Acad. Sci. Paris, 1905, vol. 140, p. 22. [M.A. **6**–124.]

Greinerite. A. K. Boldyrev, 1928. Kurs opisatelnoi mineralogii, Leningrad, 1928, part 2, p. 162 (Грейнерит). O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 48 (Грейнерит, Greinerite). A 'brown-spar' or mangandolomite, $(Mg,Mn)Ca(CO_3)_2$, from Greiner, Zillerthal, Tyrol. Named from the locality.

Halotri-alunogen. I. Suganuma, 1932. [Tokyo Buturigakkô-Zassi, vol. 41, p. 250.] Z. Harada, Journ. Fac. Sci. Hokkaido Univ., Sapporo, Ser. 4, 1936, vol. 3, p. 351 (Halotri-Alunogen). A mixture of halotrichite and alunogen.

Headdenite. P. Quensel, 1937. Geol. För. Förh. Stockholm, vol. 59, p. 95 (headdenite). A phosphate mineral $Na_2O.5(Fe,Mn,Ca)O.P_2O_5$, from South Dakota, analogous to varulite (q.v.) but with iron predominating over manganese. Named after William Parker Headden (1850–1932) of Colorado. [M.A. **6**–486.]

Herzenbergite. P. Ramdohr, 1934. Neues Jahrb. Min., Abt. A, Beil.-Bd. 68, p. 293; Zeits. Krist., 1935, vol. 92, p. 186 (Herzenbergit). W. Hofmann, Fortschr. Min. Krist. Petr., 1935, vol. 19, p. 30; Zeits. Krist., 1935, vol. 92, p. 161. To replace the preoccupied name kolbeckine (R. Herzenberg, 1932; 13th List) for tin sulphide from Bolivia, identical with artificial SnS. Named after Dr. Robert Herzenberg, of Oruro, Bolivia. [M.A. **6**–261, 262, 368.]

Heterophyllite. A. Mário de Jesus, [1936]. Com. Serv. Geol. Portugal, vol. 19 (for 1933), p. 126 (Heterofilite). A variety of biotite with a formula, $H_8K_4Fe_4Al_6Si_8O_{35}$, differing slightly from siderophyllite. From Mangualde, Portugal. [M.A. **6**–441.]

Hlopinite. *See* Khlopinite.

Hsihutsunite. C. C. Wang, 1936. Bull. Geol. Soc. China, vol. 15, p. 94 (Hsihutsunite). A variety of rhodonite containing 6·24% MgO. Named from the locality, Hsihutsun, prov. Chih-li, China. [M.A. **6**–442.]

Humite. R. Potonié, 1924. Kohlenpetrographie, Berlin, p. 1. (Humite, *pl.*). Coals derived from humic materials. Not the humit of J. L. Bournon, 1813.

Hydro-amphibole. W. Q. Kennedy and B. E. Dixon, 193 Zeits. Krist., vol. 94, p. 280. An amphibole containing more wat (5·78 %) than that required by the theoretical formula. [M.A. 6 443.]

Hydrobismutite. K. A. Nenadkevich, 1917. Bull. Acad. Sc Petrograd, ser. 6, vol. 11, p. 448 (*гидробисмутит*). Hydrated bismu carbonate, $Bi_2O_3.CO_2.2\text{–}3H_2O$, containing more water than bismutit from Transbaikal, Siberia.

Hydrobraunite, Hydroxybraunite, &c. A. K. Boldyrev, 192 Kurs opisatelnoi mineralogii, Leningrad, 1928, part 2, p. 97. O. I Shubnikova and D. V. Yuferov, Spravochnik po novym mineralan Leningrad, 1934, pp. 44–45. The following are given as members the psilomelane and wad group with the general formula $k\mathrm{Mn}$ $l\mathrm{MnO_2}.n\mathrm{H_2O}$: Hydrobraunite (Гидробраунит), Hydroxybrauni (Гидроксибраунит), Hydrohausmannite (Гидрогаусманнит), Hydr manganite (Гидроманганит), Hydromanganosite (Гидроманганози and Hydropyrolusite (Гидропиролюзит).

Hydrohetaerolite. C. Palache, 1928. Amer. Min., vol. 1 p. 308; Prof. Paper U.S. Geol. Survey, 1935, no. 180, pp. 49, 5 A mineral from New Jersey and Colorado previously described hetaerolite ($ZnO.Mn_2O_3$), but distinct from this in containing so water, the formula being $2ZnO.2Mn_2O_3.H_2O$. It is perhaps tetragon like hetaerolite. [M.A. **6**–261.]

Hydroxy-amphibole. N. L. Bowen and J. F. Schairer, 19 Amer. Min., vol. 20, p. 547 (hydroxy-amphiboles). *See* Flu amphibole.

Hydroxyl-annite, Hydroxyl-biotite, &c. D. P. Grigoriev, 19 *See* Fluor-annite.

Hyperperthite, Hyperoranite. H. L. Alling, 1921. *See* Hy perthite.

Hypoperthite, Hypo-oranite, &c. H. L. Alling, Journ. Ge Chicago, 1921, vol. 21, pp. 234, 253, 254. Hypoperthite, Eutec perthite, and Hyperperthite (Hyperthite) for intermediate memb

of the Or-Ab series. Hypo-oranite, Eutecto-oranite, and Hyperoranite for the Or-An (oranite) series. Paraperthite and Para-oranite contain also some An and Ab respectively.

Igmerald. M. Jaeger and H. Espig, 1935. Deutsche Goldschmiede-Zeitung, vol. 38, p. 347 (Igmerald). W. F. Eppler, ibid., 1935, vol. 38, no. 15, p. —. B. W. Anderson, Gemmologist, London, 1935, vol. 4, pp. 212, 295. H. Espig, Zeits. Krist., 1935, vol. 92, p. 387 (synthetische Smaragd). Trade-name for artificial emerald made by the I. G. [Interessengemeinschaft] Farbenindustrie at Bitterfeld, Germany. Named from I. G. and emerald. [M.A. **6**–200, 497.]

Iron-hypersthene. M. Saxén, 1925. Fennia, Soc. Geogr. Fenniae, Helsingfors, vol. 45, no. 11, p. 18 (Järnhypersten), p. 39 (Eisen-hypersthen). N. Sundius, Årsbok Sveriges Geol. Undersök., 1932, vol. 26, no. 2, p. 3 (Eisenhypersthen). An iron-rich hypersthene (FeO 42 %), $MgSiO_3.3FeSiO_3$. *See* Orthoferrosilite.

Iron-kaolinite. M. H. Hey, 1936. Min. Abstr., vol. 6, p. 234. 'Many nontronites appear to be ferruginous beidellites, but some seem to be iron-kaolinites.' Compare iron-beidellite (11th List).

Iron-monticellite. D. S. Belyankin, K. M. Feodotyev, and C. S. Nikogosyan, 1934. Neues Jahrb. Min., Abt. A, Beil.-Bd. 68, p. 337 (Eisen-Monticellit). The molecule $Ca_2SiO_4.Fe_2SiO_4$, as distinct from magnesium-monticellite ($Ca_2SiO_4.Mg_2SiO_4$) and mangan-monticellite ($Ca_2SiO_4.Mn_2SiO_4$).

Iron-pyroxene. C. N. Fenner, 1931. Min. Mag., vol. 22, pp. 549, 559. A general term for pyroxenes (hedenbergite, augite, &c.) rich in iron.

Iron-rhodonite. Translation of Järnrhodonit, Eisenrhodonit (M. Weibull, 1884). The original mineral, however, was proved to be sobralite (= pyroxmangite) by N. Sundius, 1931 [M.A. **4**–527, **5**–143], who transferred the name to a mineral isomorphous with rhodonite. The slag mineral called iron-rhodonite by J. H. Whiteley and A. F. Hallimond, 1919 [M.A. **1**–164] has also been identified with pyroxmangite by C. E. Tilley [M.A. **6**–529] and M. Perutz [Min. Mag. **24**–573].

Iron-strigovite. S. Palmqvist, 1935. Meddel. Lunds Geol.-Min. Inst., no. 60, p. 167 (Iron-Strigovite). The iron silicate constituent

of Liassic oolitic iron ores from Scania, Sweden, with the compositio
$2(Fe,Mg)O.(Fe,Al)_2O_3.2SiO_2.2H_2O$, as calculated from bulk analyses c
the ores. This composition is compared with G. Tschermak's hypo
thetical strigovite molecule $H_4Mg_2Al_2Si_2O_{11}$ of the chlorite group, an
the fact that actual analyses of strigovite show the presence of muc
iron is overlooked. [M.A. **6**–368.]

Iron-wollastonite. C. E. Tilley, 1937. Amer. Min., vol. 2
p. 727 (Iron wollastonite); Min. Mag., 1937, vol. 24, p. 572 (iron
wollastonites). Wollastonite with $FeSiO_3$ in solid solution, from Co
Antrim.

Ishkyldite. F. V. Syromyatnikov, 1934. Bull. Soc. Nat. Moscou
ser. 2, vol. 42 (Sect. Géol., vol. 12), pp. 566, 568 (ишкильдит), p. 57
(ishkyldite); Amer. Min., 1936, vol. 21, p. 48 (ishkyldite). A variet
of chrysotile-asbestos differing from α-chrysotile in optical characte
and X-ray pattern and with an excess of silica, $H_{20}Mg_{15}Si_{11}O_4$
Named from the locality, Ishkyldino, Volga, Russia. [M.A. **6**–259

Jachymovite. R. Nováček, 1935. Věstník Král. České Spo
Nauk, Cl. 2, for 1935, no. 7, p. 28 (jáchymovite); Čaposis Náradníh
Musea, Praha, 1935, vol. 109, p. 100. Hydrated silicate of uraniu
and copper, $CuO.2UO_3.2SiO_2.6H_2O$, afterwards proved to be identic
with cuprosklodowskite (13th List). Named from the locality
Jáchymov (= Joachimsthal), Bohemia. [M.A. **6**–149, 345.]

Japanite. I. Iwasa, 1877. [Gakugéisirin, no. 57.] Z. Harad
Journ. Fac. Sci. Hokkaido Univ., Sapporo, Ser. 4, 1936, vol.
p. 324 (Japanit). An incorrectly determined mineral from Japa
afterwards (Z. Sasamoto, 1895) identified with pennine.

Järnhypersten. M. Saxén, 1925. *See* Iron-hypersthene.

Kalianorthoklas. Z. Harada, Journ. Fac. Sci. Hokkaido Univ
Sapporo, Ser. 4, 1936, vol. 3, p. 265 (Kalianorthoklas). Germa
translation of Potash-anorthoclase (13th List). Identical with hyp
perthite (q.v.).

Kali-montmorillonit. *See* Potash-montmorillonite.

Kasoite. T. Yoshimura, 1936. Journ. Geol. Soc. Japan, vol. 4
p. 877 (Japanese). A variety of barium-felspar associated wit
celsian and hyalophane as gangue minerals in the Kaso mine, Tochig
Japan. Named from the locality. [M.A. **6**–489.

Khlopinite. I. E. Starik, 1933. Problems of Soviet Geology, vol. 3, no. 7, p. 74 (хлопинит), p. 78 (chlopinite); Rep. Intern. Geol. Congress, xvi (1933), U.S.A., 1936, vol. 1, p. 217 (chlopinite). O. M. Shubnikova and D. V. Yuferov, Report on new minerals, Leningrad, 1934, p. 104 (Хлопинит, Hlopinite). Titano-niobate of yttrium, uranium, thorium, and iron, $M_2Nb_2TiO_9.H_2O$; black, optically isotropic, from Transbaikal. Named after Professor V. G. Khlopin (В. Г. Хлопин). [M.A. **6**–258, 518.]

Kobalt-Oligonspat. R. Reissner, 1935. *See* Cobalto-sphaerosiderite.

Kolloid-calcite, Kolloid-magnesite, Kolloid-siderite. A. K. Boldyrev, 1928. Kurs opisatelnoi mineralogii, Leningrad, 1928, part 2, p. 163 (Коллоид-кальцит, Коллоид-магнезит, Коллоид-сидерит). O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 48 (*коллоид-кальцит*, kolloid-calcite; *коллоид-магнезит*, kolloid-magnesite; *коллоид-сидерит*, kolloid-siderite). Colloidal varieties of minerals of the calcite group.

Kondrikovite. I. D. Borneman-Starynkevich, 1933. Khibina apatite, Leningrad, 1933, p. 114 (кондрикит); Materials Geochem. Khibina tundra, Acad. Sci. USSR, 1935, pp. 54, 56 (кондриковит). Natrolite with microscopic inclusions of a rinkite-like mineral; apparently an alteration product of lovchorrite, which it encrusts; from the Kola peninsula, Russia. Named kondrikite, afterwards corrected to kondrikovite, after Mr. V. I. Kondrikov, President of the Apatite Trust in the Kola peninsula. [M.A. **6**–341–343.]

Kupferlovčorrit, Kupferwudjavrit. *See* Cuprolovchorrite.

Labite. N. E. Efremov, 1936. Mém. Soc. Russ. Min., ser. 2, vol. 65, p. 108 (лабит), p. 117 (labite). A yellowish-green pilolite-like mineral, consisting of matted fibres, probably orthorhombic, with a composition, $H_2MgSi_3O_8.H_2O$, near that of the picrocollite (1th List) end-member of the pilolite-palygorskite group. Named from the locality, Laba river, northern Caucasus. [M.A. **6**–439.]

Lindgrenite. C. Palache, 1935. Amer. Min., vol. 20, pp. 187, 194. Basic molybdate of copper, $2Cu_2MoO_4.Cu(OH)_2$, as green monoclinic crystals from Chile. Named after Professor Waldemar Lindgren (1860–), of Cambridge, Massachusetts. [M.A. **6**–54, 147.]

Lubumbashite. L. De Leenheer, 1934. Natuurwet. Tijds. Gen vol. 16, pp. 237, 240 (Lubumbashiet). Colloidal hydroxide cobalt (and copper), earlier compared with heterogenite (A. Schoe 1921; M.A. **1**–243). Named from the locality, Lubumbashi, Katang Belgian Congo. [M.A. **6**–52.]

Magnesia-cordierite. H. Shibata, 1936. Japanese Journ. Geo Geogr., vol. 13, p. 227 (magnesia-cordierite). Iron-free cordieri $H_2Mg_4Al_8Si_{10}O_{37}$, as distinct from iron-cordierite $H_2Fe_4Al_8Si_{10}O$ (10th List). [M.A. **6**–479.]

Magnesiodolomite. A. N. Winchell, 1927. Elements of optic mineralogy, part 2, 2nd edit., p. 75. $CaMg(CO_3)_2$ is distinguished magnesiodolomite; $CaFe(CO_3)_2$ as ferrodolomite [= iron-dolomit 11th List]; and $CaMn(CO_3)_2$ as mangandolomite [10th List]. The are given as varieties of the mineral dolomite, while in the text it stated that dolomite is a rock.

Magnesio-wüstite. N. L. Bowen and J. F. Schairer, 193 Amer. Journ. Sci., ser. 5, vol. 29, pp. 151, 194 (magnesio-wüstite Solid solutions of MgO and FeO, ranging from pure periclase (cub MgO) to 78 % FeO. But wüstite [13th List] was not defined as Fe [M.A. **6**–352.]

Magnesium-berzeliite. W. Bubeck, 1934. Geol. För. Fö Stockholm, vol. 56, p. 526 (Magnesium-Berzeliit). W. Bubeck a F. Machatschki, Zeits. Krist., 1935, vol. 90, p. 44 (Mg-Berzeli $(Ca,Na)_3Mg_2(AsO_4)_3$, as distinct from $(Ca,Na)_3Mn_2(AsO_4)_3$, manga berzeliite (2nd List). [M.A. **6**–183.]

Magnesium-chlorophoenicite. C. Palache, 1935. Prof. Pa U.S. Geol. Survey, no. 180, p. 123 (Magnesium chlorophoenicit Basic arsenate of magnesium and manganese, $(Mg,Mn)_2As_2O$ $7(Mg,Mn)(OH)_2$ monoclinic, differing from chlorophoenicite (1 List) in containing magnesium in place of zinc; from Frank Furnace, New Jersey. [M.A. **6**–261.]

Magnesium-monticellite. *See* Iron-monticellite.

Magnesium-zinc-spinel. B. W. Anderson and C. J. Pay 1937. *See* Gahnospinel.

Magnoferrichromite. A. G. Betekhtin, 1934. *See* Alun chromite.

Manganankerite. S. Koiké, 1935. [Journ. Japanese Assoc. Min. Petr. Econ. Geol., vol. 14, p. 216 (Japanese).] Z. Harada, Journ. Fac. Sci. Hokkaido Univ., Sapporo, Ser. 4, 1936, vol. 3, p. 358 (Manganankerit), p. 361 (Mangan-Ankerit). Pink ankerite containing MnO 8·60 %, from Japan.

Manganese-zoisite. L. L. Shabynin, 1934. Mém. Soc. Russ. Min., ser. 2, vol. 63, p. 456 (марганцовый цоизит), p. 457 (Mn-цоизит), p. 459 (manganese zoisite), p. 460 (Mn-zoisite). A pink zoisite containing MnO 0·47 %. [M.A. **6**–437.]

Mangan-monticellite. *See* Iron-monticellite.

Manganomelane. F. Klockmann, 1922. Lehrbuch der Mineralogie, 7–8th edit., p. 422 (Manganomelan). Group name for gel forms of MnO_2, including psilomelane, wad, &c. Named from manganese and *μελᾶς, -ᾶνος*, black. [M.A. **6**–53.]

Mangan-wollastonite. V. M. Goldschmidt, 1911. Skrifter Videnskap. Kristiania, Mat.-nat. Kl., 1911, vol. 1, no. 1, p. 331 (Manganwollastonit). A variety of wollastonite containing manganese (MnO 7 %).

Mangualdite. A. Mário de Jesus, [1936]. Com. Serv. Geol. Portugal, vol. 19 (for 1933), p. 141 (Mangualdite). Phosphate of manganese and calcium, $3RO.P_2O_5$, as olive-green orthorhombic (?) crystals. Named from the locality, Mangualde, Portugal. [M.A. **6**–441.]

Marahuite. O. A. Derby, 1907. Journ. Geol. Chicago, vol. 15, p. 231 (Marahuite). O. Stutzer, Zeits. Deutsch. Geol. Gesell., 1935, vol. 87, p. 616 (Marahunit). An earthy bituminous lignite containing algae and corresponding with boghead coal. Named from the locality, Marahú, Bahia, Brazil.

Maxixe-aquamarine, Maxixe-beryl. G. O. Wild, Centr. Min., Abt. A, 1933, p. 38 (Maxixe-Aquamarine, *pl.*); K. Schlossmacher and H. Klang, Zentr. Min., Abt. A, 1935, p. 37; W. Roebling and H. W. Trommau, ibid., p. 134 (Maxixeberyll). A gem beryl of unusual blue colour and pleochroism from Maxixe mine, Minas Geraes, Brazil. The mine, now abandoned, was named from 'machiko' (a gherkin), because of the rugged corroded surface of the beryl, and 'maxixe' is apparently a German modification of this. [M.A. **5**–295; **6**–201.]

Melnikovite-pyrite. H. Schneiderhöhn and P. Ramdohr, 1931. Lehrbuch der Erzmikroskopie, Berlin, vol. 2, p. 170 (Melnikovit-Pyrit), p. 173 (Melnikovitpyrit). Shelly concentric mixtures of pyrite and marcasite crystallized from a gel, which is assumed to be identical with melnikovite (6th List).

Mercallite. G. Carobbi, 1935. Rend. R. Accad. Lincei, Cl. Sci. fis. mat. nat. Roma, ser. 6, vol. 21, sem. 1, p. 385 (mercallite). Potassium hydrogen sulphate, $KHSO_4$, as minute orthorhombic crystals in a saline efflorescence from Vesuvius. Named after Prof. Giuseppe Mercalli (1850–1914), a former Director of the Vesuvian Observatory. [Misenite, described by A. Scacchi in 1849 as $KHSO_4$, has been proved to be monoclinic $K_2SO_4.6KHSO_4$.] [M.A. **6**–148.]

Mesquitelite. A. Mário de Jesus, [1936]. Com. Serv. Geol. Portugal, vol. 19 (for 1933), p. 136 (Mesquitelite). A clayey alteration product of felspar with a formula, $(Mg,Ca)O.2Al_2O_3.9SiO_2.5H_2O$, slightly different from that of montmorillonite. Named from the locality, Mesquitela, near Mangualde, Portugal. [M.A. **6**–441.]

Meta-bentonite. C. S. Ross, 1928. Bull. Amer. Assoc. Petroleum Geol., vol. 12, p. 164 (meta-bentonites). V. T. Allen, Journ. Geol. Chicago, 1932, vol. 40, p. 259. Metamorphosed bentonite as altered volcanic tuffs in Palaeozic rocks.

Metagreenalite. F. Jolliffe, 1935. Amer. Min., vol. 20, pp. 406–411. The crystalline equivalent of the amorphous greenalite (4th List), with the composition $3FeO.4SiO_2.2H_2O$, occurring as green granules in the iron ores of Minnesota. J. W. Gruner, Amer. Min. 1936, vol. 21, p. 449. considers this to be coarser grained greenalite with the composition $9FeO.Fe_2O_3.8SiO_2.8H_2O$. [M.A. **6**–152, 480; Min. Mag. **24**–434.]

Metahalloysite. M. Mehmel, 1935. Zeits. Krist., 1935, vol. 90 p. 35; Chemie der Erde, 1937, vol. 11, p. 9 (Metahalloysit). Halloysite ($H_4Al_2Si_2O_9 + 2H_2O$) when partially dehydrated at 50° C. loses $2H_2O$, then having the kaolin formula $H_4Al_2Si_2O_9$ but with a distinct crystal-structure. [M.A. **6**–181.]

Metakernite. H. Menzel, H. Schulz, and H. Deckert, 1935. Die Naturwissenschaften, vol. 23, p. 832 (Metakernit). The amorphous

dihydrate, $Na_2B_4O_7.2H_2O$, produced artificially by the partial dehydration of kernite ($Na_2B_4O_7.4H_2O$).

Metataenite. J. D. Buddhue, 1936. *See* Orthotaenite.

Metatriplite. A. Mário de Jesus, [1936]. Com. Serv. Geol. Portugal, vol. 19 (for 1933), p. 146 (Metatriplite). A black alteration product of triplite with the composition $6MnO.3Fe_2O_3.3P_2O_5.2RF_2.4H_2O$. From Mangualde, Portugal. [M.A. **6**–442.]

Mindigite. L. De Leenheer, 1934. Natuurwet. Tijdschrift, Gent, vol. 16, pp. 237, 240 (mindigiet), p. 241 (mindigite). Hydroxide of cobalt and copper, $9Co_2O_3.2CuO.16H_2O$, as pitch-black colloidal material, from Mindigi, Katanga, Belgian Congo. Named from the locality. [M.A. **6**–52.]

Natronmargarit. C. Hintze, Handbuch der Mineralogie, Ergänzungsband, 1936, p. 390. A German form of Soda-margarite (12th List).

Neokaolin. A. E. Fersman, 1935. Scientific study of Soviet mineral resources, New York, p. 76 (neokaolin). Kaolin produced artificially from nepheline.

Neopurpurite. A. Mário de Jesus, [1936]. Com. Serv. Geol. Portugal, vol. 19 (for 1933), p. 149 (Neopurpurite). An alteration product of lithiophilite, with a formula, $7(Fe,Mn)_2O_3.5P_2O_5.4H_2O$, slightly different from that of purpurite. From Mangualde, Portugal. [M.A. **6**–442.]

Niggliite. D. L. Scholtz, 1936. Publ. Univ. Pretoria, 1936, ser. 2, no. 1, p. 184; preprint from Trans. Geol. Soc. South Africa, 1937, vol. 39 (for 1936), p. 184. Platinum telluride ($PtTe_3$?) as isotropic silver-white grains from South Africa. Named after Professor Paul Niggli (1888–) of Zürich. [M.A. **6**–440.]

Oborite. T. L. Ho, 1935. Bull. Geol. Soc. China, vol. 14, p. 279 (Oborite). An undetermined mineral presumed to contain rare-earths (La,Ce,Yt,Er), as minute grains (rhombohedral) in fluorite from Beiyin Obo, Inner Mongolia. With beiyinite (q.v.), named from the locality. [M.A. **6**–151.]

Orthoferrosilite. N. F. M. Henry, 1935. Min. Mag., vol. 24, p. 266; 1937, vol. 24, p. 528. Hypothetical end-member $FeSiO_3$ of

the enstatite-hypersthene series of orthorhombic pyroxenes. Named from analogy with ferrosilite (H. S. Washington, 1903; 9th List) and clinoferrosilite (q.v.). Synonym of iron-hypersthene (q.v.).

Orthotaenite. J. D. Buddhue, 1936. Popular Astronomy, Northfield, Minnesota, vol. 44, p. 512 (orthotaenite). Taenite of the composition Fe_2Ni is called orthotaenite; while material ranging up to Fe_7Ni, due to admixture with kamacite, is called metataenite. [M.A. **6**–390.]

Oxide-pearlite. C. Benedicks, 1912. Compt. Rend. XI Congr. Géol. Internat. (Stockholm, 1910), 1912, vol. 2, p. 888 (perlit à oxyde); M. Schwarz, Zentr. Min., Abt. A, 1937, p. 85 (Oxyd-Perlit). Pearlite in which the lamellae of ferrite (Schwarz says those of cementite) have been altered to iron oxide, occurring as a constituent of the native iron in basalt at Ovifak in Greenland and at Bühl near Kassel in Germany. [M.A. **6**–528.]

Padparadschah. A. K. Coomaraswamy, Administration Report, Ceylon, for 1904, part 4, Mineralogical Survey, 1905, p. E16 (Padmaragaya). M. Bauer, Edelsteinkunde, Leipzig, 2nd edit., 1909, p. 363 (patparachan). R. Brauns, Künstliche Schmucksteine, Handwörterbuch der Naturwissenschaften, 1913, vol. 8, p. 968 (Padparadschah). German corruptions (with other variations) of the Sinhalese padmaragaya, from padma, lotus, and raga, colour. A trade-name for reddish-yellow gem corundum, now used mostly especially for the artificially produced material. [M.A. **6**–198.]

Paraperthite, Para-oranite. H. L. Alling, 1921. *See* Hyperperthite.

Parawollastonite. M. A. Peacock, 1935. Amer. Journ. Sci. ser. 5, vol. 30, pp. 495, 525. Monoclinic calcium metasilicate, $CaSiO_3$, the name wollastonite being reserved for the more common triclinic modification of this compound. [M.A. **6**–260.]

Parkerite. D. L. Scholtz, 1936. Publ. Univ. Pretoria, 1936, ser. 2, no. 1, p. 186; preprint from Trans. Geol. Soc. South Africa, 1937, vol. 39 (for 1936), p. 186. Nickel sulphide, Ni_2S_3 or NiS_2, monoclinic, from South Africa. Named after Professor Robert Lulin Parker of Zürich. [M.A. **6**–440.]

Pholidoide. K. Smulikowski, 1936. Arch. Min. Tow. Nauk Warszaw. (Arch. Min. Soc. Sci. Varsovie), vol. 12, pp. 165 (pholidoïde

p. 180 (folidoid). The group of aluminous glauconites grading into normal (ferruginous) glauconite and occurring in sedimentary rocks. To replace the name phyllite of J. L. Thiébaut (q.v.) and including skolite (q.v.). Named from φολιδοειδης, scale-like. Not the pholidolite of G. Nordenskiöld, 1890, although near to this in composition. [M.A. **6**–345.]

Phyllite. A general term used by some French authors for the scaly minerals micas, chlorites, and clays (J. de Lapparent, Leçons de pétrographie, Paris, 1923, p. 255), and more recently applied to minerals with a layered crystal-structure. J. L. Thiébaut (Contribution à l'étude des sédiments argilo-calcaires du bassin de Paris, Nancy, 1925, p. 46) found the phyllitic constituent of marls to be near bravaisite or glauconite in composition. This has since been named pholidoide (q.v.). Phyllite of T. Thomson (1828) is a synonym of ottrelite. Phyllite (C. F. Naumann, 1849), a variant of the French phyllade (A. Brongniart, 1813), is in common use for a slaty-schistose rock. Also a general term for fossil plant leaves.

Plumbodolomite. W. Siegl, 1936. Min. Petr. Mitt. (Tschermak), vol. 48, p. 288 (Plumbodolomit). A variety of dolomite containing some lead, from Kreuth, Carinthia. [M.A. **6**–529.]

Plumbosynadelphite. C. S. Hurlbut, 1937. Amer. Min., vol. 22, p. 531. A variety of synadelphite containing some lead (PbO 3·24%), forming a red outer zone on colourless crystals of synadelphite. [M.A. **6**–488.]

Potash-aegirine. G. T. Faust, Amer. Min., 1936, vol. 21, p. 737 (potassium-aegerite). Translation of Kaliägirin (8th List).

Potash-albite, &c. H. L. Alling, 1921. Journ. Geol. Chicago, vol. 29, p. 252 (potash albite, &c.). T. Tomita, Journ. Shanghai Sci. Inst., Sect. 2, 1933, vol. 1, p. 7; 1934, vol. 1, pp. 112, 116 (potash-albite, &c.). Potash-soda-lime felspar series, including potash-albite, potash-oligoclase (5th List), potash-andesine, potash-labradorite, potash-bytownite, and potash-anorthite, containing more than 10% of the potash component $KAlSi_3O_8$.

Potash-montmorillonite. V. T. Allen, 1932. Journ. Geol. Chicago, vol. 40, p. 263 (potash-montmorillonite); abstract in Neues Jahrb. Min., Ref. III, 1933, p. 1174 (Kali-Montmorillonit). A clay

mineral of the meta-bentonites (q.v.) with high potash (K_2O 4·60 %) and low water, from Missouri.

Potash-nepheline. A. Holmes, Min. Mag., 1936, vol. 24, p. 41 (potash-nepheline). A potash-rich nepheline. Not the same a Kalinephelin (Dana), Kali-Nephelin (Hintze), a synonym of kalio philite.

Pseudo-copiapite. H. Ungemach, 1935. Bull. Soc. Franç. Min. vol. 58, p. 154. A crystallographically aberrant form of copiapit from Chile. [M.A. **6**–149.]

Pseudopalaite. A. Mário de Jesus, [1936]. Com. Serv. Geol Portugal, vol. 19 (for 1933), p. 151 (Pseudopalaíte). An alteratio product of lithiophilite, with a formula, $6(Mn,Fe)O.2P_2O_5.5H_2C$ slightly different from that of palaite. From Mangualde, Portuga [M.A. **6**–442.]

Reniformite. O. M. Shubnikova and D. V. Yuferov, Report o new minerals, Leningrad, 1934, p. 30 (Ренифомит, Reniformite The correct spelling of reniforite (11th List), since the name evidentl has reference to the reniform structure of the mineral. The miner has since been proved to be identical with jordanite (M. Watanab and N. Nakano, Journ. Japanese Assoc. Min. Petr. Econ. Geol., 193 vol. 15, p. 216).

Repossite. E. Grill, 1935. Periodico Min. Roma, vol. 6, p. 2 Phosphate of iron, manganese, and calcium, $(Fe,Mn,Ca)_3(PO_4)_2$, i pegmatite from Lake Como. Evidently identical with graftonit Named after Emilio Repossi (1876–1931), Professor of Mineralog University of Torino. [M.A. **6**–52.]

Roweite. H. Berman and F. A. Gonyer, 1937. Amer. Min vol. 22, p. 301. Hydrated borate $H_2(Mn,Mg,Zn)Ca(BO_3)_2$ as light brown orthorhombic crystals, differing from sussexite in containin calcium. Named after Mr. George Rowe, a mine captain at Frankli Furnace, New Jersey, where he collected the mineral. [M.A. **6**–488

Sahlinite. G. Aminoff, 1934. Geol. För. Förh. Stockholm vol. 56, p. 493 (Sahlinite). Very basic chloro-arsenate of lead, $12PbO.As_2O_5.2PbCl_2$, as yellow monoclinic scales, from Långban, Sweden Named after Dr. Carl Sahlin, formerly manager of the iron works a Laxå, Sweden. [M.A. **6**–51.]

Sapropelite. H. Potonié, 1906. Abhand. Preuss. Geol. Landesanst., no. 49, pp. 12, 21 (Sapropelite, *pl.*). R. Potonié, Kohlenpetrographie, Berlin, 1924, p. 4. Coals derived from algal materials. Named from σαπρός, putrid, and πηλός, mud.

Scheteligite. H. Bjørlykke, 1937. Norsk Geol. Tidsskrift, vol. 17, p. 47 (scheteligite). $(Ca,Fe,Mn,Sb,Bi,Yt)_2(Ti,Ta,Nb,W)_2(O,OH)_7$, as black orthorhombic (?) crystals in pegmatite from Iveland, Norway. Named after Professor Jakob Grubbe Cock Schetelig (1875–1935) of Oslo. [M.A. **6**–487.]

Seminephrite. F. J. Turner, 1935. Trans. Roy. Soc. New Zealand, vol. 65, p. 190 (Seminephrites). The New Zealand 'greenstones' include besides interfelted fibrous nephrite also more coarsely crystalline tremolite as acicular prisms and sheaves of parallel fibres. The term is introduced rather as a rock-name for forms intermediate between nephrite and tremolite-schist. [M.A. **6**–501.]

Serpentine-jade. R. Brauns, 1929. Deutsche Goldschmiede-Zeitung, vol. 32, nos. 3,13; Handwörterbuch der Naturwissenschaften, 2nd edit., 1933, vol. 8, p. 1094 (Serpentin-Jade). A serpentine from China resembling jade, used as an ornamental stone [cf. bowenite]. Other jade-like minerals are distinguished as Garnet-jade (Granatjade, Transvaal-Jade) and Vesuvian-Jade (= Californite, 4th List).

Skolite. K. Smulikowski, 1936. Arch. Min. Tow. Nauk. Warszaw. (Arch. Min. Soc. Sci. Varsovie), vol. 12, p. 145 (Skolite), p. 179 (Skolit). A dark green, finely scaly mineral, $H_4K(Mg,Fe'',Ca)(Al,Fe''')_3Si_6O_{20}.4H_2O$, of the glauconite group and close to bravaisite, occurring in sandstone at Skole, eastern Carpathians, Poland. Named from the locality. [M.A. **6**–345.]

Sosmanite. H. Schneiderhöhn and P. Ramdohr, 1931. Lehrbuch der Erzmikroskopie, vol. 2, p. 537 (Sosmanit). Synonym of maghemite (P. A. Wagner, 1927; 12th List) for magnetic ferric oxide (γ-Fe_2O_3). Named after Dr. Robert Browning Sosman (1881–), formerly of the Geophysical Laboratory, Washington, D.C., who described the mineral in 1925. [M.A. **3**–217.]

Steigerite. E. P. Henderson, 1935. Amer. Min., vol. 20, p. 769. Hydrated vanadate of aluminium, $Al_2O_3.V_2O_5.6\frac{1}{2}H_2O$, as a canary-yellow amorphous powder in sandstone from Colorado. Named after

Dr. George Steiger (1869–), formerly chief chemist of the United States Geological Survey. [M.A. **6**–260.]

Strontium-aragonite. C. O. Hutton, 1936. Trans. Roy. Soc. New Zealand, vol. 66, p. 36 (Strontium-aragonite). A variety of aragonite containing $SrCO_3$ 5·51 %, from Otago. Synonym of mossoite. [M.A. **6**–364.]

Sungulite. G. A. Sokolov, 1925. Bull. Sci.-Techn. Circle Metal. & Chem., Leningrad Polytechn. Inst., no. 1 (2), p. 74; Trans. Geol. Prospecting Service USSR, 1931, no. 56, p. 32 (сунгулит). A variety of serpentine from Sungul lake, Kyshtym, Urals. Named from the locality. [M.A. **6**–219, 436.]

Talasskite. V. D. Nikitin, 1936. Mém. Soc. Russ. Min., ser. 2, vol. 65, p. 282 (талассκит), p. 288 (talasskite). A variety of fayalite containing Fe_2O_3 12·07 %. Named from the locality, the Talas valley, Kirghiz republic, Siberia. [M.A. **6**–439.]

Taosite. J. de Lapparent, 1935. Compt. Rend. Acad. Sci. Paris, vol. 201, p. 156. A form of alumina distinct from corundum, occurring in the emery of Samos. Named from *ταώς*, a peacock, the emblem of Hera (Juno) at Samos. [M.A. **6**–150.]

Thioelaterite. B. L. Dunicz, 1936. Arch. Min. Tow. Nauk Warszaw. (Arch. Min. Soc. Sci. Varsovie), vol. 12, p. 90 (tioelaterite), p. 95 (tioélaterite, tioélatérite). An elastic bitumen containing 3 % of sulphur (*θεῖον*), from Bolivia: a natural vulcanized caoutchouc = elaterite. [M.A. **6**–344.]

Titangarnet, Titanhornblende, Titanmica, Titantourmaline. W. Kunitz, 1936. Neues Jahrb. Min., Abt. A, Beil.-Bd. 70, p. 3 (Titangranate, *pl.*), p. 385 (Titanhornblenden), p. 397 (Titan-Hornblenden), p. 399 (Titanglimmer), p. 401 (Titan-Glimmer), p. 3 (Titanturmaline, *pl.*). Titaniferous silicates analogous to titanaugite (4th List), titanbiotite (9th List), titanolivine (A. Damour, 1879).

Titanpigeonite. T. Tomita, 1933. Journ. Shanghai Sci. Inst. Sect. 2, vol. 1, p. 3 (titan-pigeonite); 1934, vol. 1, p. 120 (titan-pigeonite). A variety of titanaugite related to pigeonite. [M.A. **6**–11

Todorokite. T. Yoshimura, 1934. Journ. Fac Sci. Hokkaido Univ., Sapporo, Ser. 4, vol. 2, p. 289 (todorokite). Hydrated manganese oxide or manganate with some Ca,Ba,Mg, formula 2(RO.Mn

$2H_2O).3(Mn_2O_3.3MnO_2.2H_2O)$, probably monoclinic; from Todoroki mine, Hokkaido, Japan. Named from the locality. [M.A. **6**–53.]

Trieuite. L. De Leenheer, 1935. Natuurwet. Tijdschrift, Gent, vol. 17, p. 91 (trieuiet), p. 95 (trieuite). Hydrated oxide of cobalt and copper, $2Co_2O_3.CuO.6H_2O$; a black amorphous mineral differing from heterogenite in containing no CoO. From Katanga. Named after Robert du Trieu de Terdonck, chief geologist of the Union Minère du Haut Katanga. Cf. Mindigite. [M.A. **6**–152.]

Trimontite. I. Iwasa, 1877. [Gakugéisirin, no. 57.] Z. Harada, Journ. Fac. Sci. Hokkaido Univ., Sapporo, Ser. 4, 1936, vol. 3, p. 357 (Trimonit, Trimontit). Analysis gave the composition $5CaO.3WO_3$, but the mineral was afterwards (T. Wada, 1904) proved to be scheelite, $CaWO_4$. Named from the locality, San-no-také (= three-of-mountains), Hukuoka, Japan.

U-galena. P. F. Kerr, 1935. Amer. Min., vol. 20, p. 443. Galena containing uranium lead of isotope Pb^{206}. [M.A. **6**–152.]

Ungemachite. M. A. Peacock and M. C. Bandy, 1936. Amer. Min., 1936, vol. 21, no. 12, pt. 2, p. [2]; 1937, vol. 22, p. 207. Hydrated basic sulphate of sodium, potassium, and ferric iron, $Na_4(K,Fe''')_2(OH)(SO_3)_3.5H_2O$, as colourless rhombohedral crystals, from Chile. Named after Dr. Henri Léon Ungemach (1880 ?–1936) of Strasbourg. *See* Clino-ungemachite. [M.A. **6**–443.]

Uxporite. O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934, p. 57. Still another spelling of yuksporite, юкспорит (10th List), juxporite and juksporite (11th List).

Vanado-magnetite. A. M. Heron, 1936. Rec. Geol. Surv. India, vol. 71, p. 44 (vanado-magnetite). G. H. Tipper, Bull. Imp. Inst. London, 1936, vol. 34, p. 451. A magnetic iron ore containing variable amounts of vanadium (V_2O_5 up to 8 %) and titanium (up to 25 %), from Bihar, India. Later named coulsonite (q.v.). [M.A. **6**–489.]

Varulite. P. Quensel, 1937. Geol. För. Förh. Stockholm, vol. 59, p. 95 (varulite). A phosphate mineral $Na_2O.5(Mn,Fe,Ca).2P_2O_5$, presumably orthorhombic, occurring as olive-green granular masses

at Varuträsk, northern Sweden. Named from the locality. [M.A. **6**–486.]

Vittinkite. M. Saxén, 1925. Fennia, Soc. Geogr. Fenniae, Helsingfors, vol. 45, no. 11, p. 24 (Vittinkit). A variant of wittingite (N. Nordenskiöld, 1849), a synonym of neotocite. Named from the locality, Vittinki (Wittingi), SE. Bothnia, Finland.

Vudyavrite. I. D. Borneman-Starynkevich, 1933. Khibina Apatite, Leningrad, 1933, p. 114 (вудъяврит); Materials Geochem. Khibina tundra, Acad. Sci. USSR, 1935, pp. 43, 62; P. N. Chirvinsky, ibid., p. 89 (Wudjavrit). A. E. Fersman, The scientific study of Soviet mineral resources, New York, 1935, p. 49 (vudiavrite). Hydrated titano-silicate of cerium earths, $Ce_4(Ti_2O_6)_3.nSiO_2.mH_2O$, as a yellowish amorphous glassy alteration product of lovchorrite, from Vudyavrchorr (Вудъяврчорр), Kola peninsula, Russia. Named from the locality. [M.A. **6**–341–343.]

Warrenite. A. K. Boldyrev, 1928. Kurs opisatelnoi mineralogii Leningrad, 1928, part 2, p. 162 (Варренит). O. M. Shubnikova and D. V. Yuferov, Spravochnik po novym mineralam, Leningrad, 1934 p. 48 (Варренит, Warrenite). A pink variety of smithsonite containing cobalt (CoO 10·25%), from Boleo, Lower California, Mexico. Named after Professor Charles Hyde Warren (1876–), of Yale University, who analysed the mineral in 1898. Synonym of Cobaltsmithsonite (12th List). Not the warrenite of L. G. Eakins (1888) or of S. F. Peckham (1895; 2nd List).

Wotanite. W. Kunitz, 1936. Neues Jahrb. Min., Abt. A., Beil. Bd. 70, p. 399 (Wotanite, *pl.*). Variant of wodanite (9th List).

Wudjavrit. *See* Vudyavrite.

Yamagutilite. K. Kimura, 1933. [Rep. Japanese Assoc. Adv. Sci., vol. 8, p. 157 (Japanese).] Z. Harada, Journ. Fac. Sci. Hokkaido Univ., Sapporo, Ser. 4, 1936, vol. 3, p. 298 (Yamagutilith). A variety of zircon containing P_2O_5 4·23, rare-earths 15·89, HfO_2 *ca.* 3·4%, &c. from Yamaguti, Nagano, Japan. Named from the locality.

Zinntitanit. P. Ramdohr, 1935. Neues Jahrb. Min., Abt. A. Beil.-Bd. 70, p. 15 (Zinntitanit). A variety of sphene containing 10% of tin, from Arandis, South-West Africa. [M.A. **6**–368.]

SYSTEMATIC CLASSIFICATION OF NEW MINERALS[1]

Elements

Aurosmirid, Ir,Os,Au.
Cuproplatinum, var. of platinum.

Sulphides, etc.

Herzenbergite, SnS.
Parkerite, Ni_2S_3(?).
Blockite, (Ni,Cu)Se_2.
Higgliite, $PtTe_3$(?).

Haloids

Bismoclite, BiOCl.

Oxides

Cosmanite, magnetic γ-Fe_2O_3.
Laosite, Al_2O_3.
Vanado-magnetite (coulsonite), FeO.(Fe,V)$_2O_3$(?)

Hydroxides

Hydrohetaerolite, $2ZnO.2Mn_2O_3.H_2O$.
Goodtite, $5Co_2O_3.CuO.Fe_2O_3.11H_2O$.
Hydigite, $9Co_2O_3.2CuO.16H_2O$.
Heuite, $2Co_2O_3.CuO.6H_2O$.
Todorokite, $\left.\begin{matrix}2(RO.MnO_2.H_2O)\\3(Mn_2O_3.3MnO_2.2H_2O)\end{matrix}\right\}$.

Aluminates

Chromochromite, $Fe(Cr,Al)_2O_4$.
Pahnospinel, $(Mg,Zn)Al_2O_4$.

Carbonates

Cobalto-sphaerosiderite, (Fe,Mn,Mg,Co,Ca)CO_3.
Beksputite, $6PbO.Bi_2O_3.3CO_2$.
Hydrobismutite, $Bi_2O_3.CO_2.2$–$3H_2O$.

Sulphates, etc.

Percallite, $KHSO_4$.
Sagemachite, $Na_4(K,\overset{\frown}{Fe'''})_2(OH)(SO_3)_3.5H_2O$.
Pseudo-copiapite, $2Fe_2O_3.5SO_3.17H_2O$.
Ilfeldite, Ni selenate (?)
Hydrogrenite, $2Cu_2MoO_4.Cu(OH)_2$.
Ferri-paraluminite, $2(Al,Fe)_2O_3.SO_3.15H_2O$.

Borates

Metakernite, $Na_2B_4O_7.2H_2O$.
Roweite, $H_2(Mn,Mg,Zn)Ca(BO_3)_2$.

Phosphates, etc.

Cerapatite, var. of apatite.
Repossite, $(Fe,Mn,Ca)_3(PO_4)_2$.
Mangualdite, $3(Mn,Ca)O.P_2O_5$.
Clino-triphylite, $Li(Fe,Mn)PO_4$.
Ferri-sicklerite (Li,Fe‴,Mn″)PO_4.
Headdenite, $Na_2O.5(Fe,Mn,Ca)O.2P_2O_5$.
Varulite, $Na_2O.5(Mn,Fe,Ca)O.2P_2O_5$.
Bermanite, $(Mn,Mg)^{\prime\prime}_5(Mn,Fe)^{\prime\prime\prime}_8(PO_4)_8(OH)_{10}.15H_2O$.
Magnesium-chlorophoenicite, $(Mg,Mn)_2As_2O_8.7(Mg,Mn)(OH)_2$.
Neopurpurite, $7(Fe,Mn)_2O_3.5P_2O_5.4H_2O$.
Pseudopalaite, $6(Mn,Fe)O.2P_2O_5.5H_2O$.
Metatriplite, $6MnO.3Fe_2O_3.3P_2O_5.2RF_2.4H_2O$.
Austinite, $CaZn(OH)AsO_4$.
Sahlinite, $12PbO.As_2O_5.2PbCl_2$.
Magnesium-berzeliite, $(Ca,Na)_3Mg_2(AsO_4)_3$.
Arsentsumebite, var. of tsumebite.
Steigerite, $Al_2O_3.V_2O_5.6\frac{1}{2}H_2O$.
Cuprovanadinite, var. of vanadinite.

Niobates, etc.

Khlopinite, $(Yt,U,Th,Fe)_2Nb_2TiO_9.H_2O$.
Scheteligite, $(Ca,Fe,Mn,Sb,Bi,Yt)_2(Ti,Ta,Nb,W)_2(O,OH)_7$.

Silicates

Kasoite, barium-felspar.
Iron-hypersthene, Orthoferrosilite $\left.\begin{matrix}\\\end{matrix}\right\}$ $FeSiO_3$.
Clinoferrosilite, $FeSiO_3$.
Astridite, chromojadeite.
Parawollastonite.
Iron-wollastonite.
Mangan-wollastonite.

Only a selection of the names given in the preceding alphabetical list are here included.

Hsihutsunite, var. of rhodonite.
Fluor-amphibole, $F_2R''_7(Si_4O_{11})_2$.
Hydro-amphibole.
Dashkesanite, chlor-amphibole.
Chrome-tremolite.
Talasskite, $(Fe'',Mg)_5Fe'''(SiO_4)_3$.
Yamagutilite, var. of zircon.
Heterophyllite, var. of biotite.
Chrome-epidote.
Manganese-zoisite.
Ferro-chrysotile, $H_4Fe_3Si_2O_9$.
Ishkyldite, $H_{10}Mg_{15}Si_{11}O_{47}$.
Metahalloysite, $H_4Al_2Si_2O_9$.
Potash-montmorillonite.
Ermakite, $(Al,Fe)_2O_3.3SiO_2.2H_2O$.
Attapulgite
$\left.\begin{matrix} x[9SiO_2.6(Mg,Fe'',Ca)O.12H_2O] \\ y[9SiO_2.2(Al,Fe''')_2O_3.12H_2O]. \end{matrix}\right\}$
Aidyrlite, $2NiO.2Al_2O_3.3SiO_2.7\frac{1}{2}H_2O$.
Labite, $H_2MgSi_3O_8.H_2O$.
Mesquitelite,
$(Mg,Ca)O.2Al_2O_3.9SiO_2.5H_2O$.
Skolite,
$H_4K(Mg,Fe,Ca)(Al,Fe)_3Si_6O_{20}.4H_2O$
Iron-strigovite,
$2(Fe,Mg)O.(Fe,Al)_2O_3.2SiO_2.2H_2O$.
Calcium-rinkite,
$3CaTiO_3.10(Ca,Na_2,H_2)SiO_3.3CaF_2$.
Vudyavrite, $Ce_4(Ti_2O_6)_3.nSiO_2.mH_2O$.
Zinntitanit, sphene with Sn.

Hydrocarbons

Earlandite, $Ca_3(C_6H_5O_7)_2.4H_2O$.
Fluorene, $C_{13}H_{10}$.
Anthracene, $C_{14}H_{10}$.
Bacalite, var. of amber.
Enelectrite.
Carbocer.
Carburan.
Broggite, var. of asphaltum.
Thioelaterite.
Marahuite.

MINERALOGICAL ABSTRACTS

(Vol. 6, No. 11, September, 1937.)

Notices of Books.

Gatterer (A.) & Junkes (J.). *Arc spectrum of iron from 8388–2242 A.* Castel Gandolfo (Specola Vaticana), 1935, 10 pp. text, 21 pls., in folder. Price $8.00.

—— —— *Spark spectrum of iron from 4650 to 2242 A.* Ibid., 1935, 9 pp. text, 13 pls. Price $4.00.

—— —— *Atlas der Restlinien von 30 chemischen Elementen.* Ibid., 1937, 33 pp. text and 36 pp. tables as separate booklets, 28 pls., in folder. Price RM. 50.

Some years ago the Astrophysical Laboratory of the Vatican Observatory at Castel Gandolfo started systematic research work on spectrographic analysis, especially with the aim of investigating meteorites. Three publications have so far been issued as a result of that research work, which will be very useful for any laboratory working on chemical analysis by means of optical spectra. The first two publications give reproductions of the arc and spark spectra of iron on beautiful large photographs, indicating the wave-lengths of every line. Everybody who knows the importance of careful calibration of spectra by means of the iron lines will appreciate these very helpful plates, and will admire their excellent technique. The most recent publication, the Atlas of the 'last lines' of thirty chemical elements, likewise gives unsurpassed large dispersion spectra, reproduced beautifully as twenty-eight photographs of the size 30 × 40 cm., accompanied by tables of wave-lengths and descriptive text. The spectra from the Specola Vaticana with regard to dispersion and resolution are far in advance of any corresponding publications of earlier date. They will prove a most useful tool for any work concerning spectrum analysis of minerals, ores, and rocks.

V. M. Goldschmidt.

Rogers (Austin Flint). *Introduction to the study of minerals.* With a section on *Microchemical analysis* by Lloyd W. Staples. 3rd edition, New York & London (McGraw-Hill Book Co.), 1937, xviii + 626 pp., 1 pl., 730 text-figs. Price 30*s.*

The first edition of this useful general text-book on mineralogy appeared in 1912 as a smaller sized volume [Min. Mag. **16**–305], and the present third edition shows considerable alterations and additions.

The geometrical forms of crystals are very clearly set out, and 48 simple forms are listed, it being explained that a dome results from reflection in a plane and a sphenoid from rotation about an axis [M.A. **6**–453]. The chemical section contains a new chapter on micro-chemical analysis by L. W. Staples [M.A. **6**–431]. Part II gives excellent descriptions of 222 more important minerals and 'mineraloids', the latter including opal, pyrolusite, limonite, cliachite, psilomelane, and collophane. The derivation and pronunciation of each mineral name and its French and German equivalents are given, as well as the author and date of introduction. Part III gives a useful account of the occurrence, association, and origin of minerals. The book is very clearly printed and well illustrated.

L. J. S.

Winchell (Alexander N.). *Elements of optical mineralogy: an introduction to microscopic petrography. Part I. Principles and methods.* 5th edition, New York (J. Wiley & Sons) and London (Chapman & Hall), 1937, xii + 263, 4 pls., 267 text-figs. Price 17*s.* 6*d.*

The first edition of this successful text-book by N. H. and A. N. Winchell appeared in 1909, and a second edition of Part I by A. N. Winchell appeared as a separate volume in 1922 [M.A. **2**–2]. The present edition shows an increase of nineteen pages over the fourth edition of 1931 [M.A. **5**–2]. Beyond some corrections and additions and revision of the illustrations, there are no great changes. The title-page states 'with over 300 illustrations', but there are only 267 numbered text-figures. In the preface the author acknowledges assistance from his son H. Winchell. It is interesting to find this American text-book running through three generations of authors: Dana's 'System of Mineralogy' (six editions, 1837–92) was covered by two generations.

L. J. S.

Mendonça (Benjamim da Conceição). *Elementos de mineralogia morfológica. Cristalografia geométrica.* Lisboa (edição do autor), 1936, 240 pp., 12 sheets of tables, 341 figs.

The larger part of this volume on geometrical crystallography is occupied by a laborious deduction of the forms and classes of crystals by a systematic suppression of faces in all possible symmetrical arrangements. By this process the author arrives at 33 (instead of 32) crystal-classes; but his supposed new class of the hexagonal system is the same as the quartz class when rotated through 30°

about the principal axis. There are short chapters on the physical properties of crystals (principally hardness) and on crystal-optics.

L. J. S.

JOHANNSEN (Albert). *A descriptive petrography of the igneous rocks.* Vol. 3. *The intermediate rocks.* Chicago (Univ. Chicago Press), 1937, xiv + 360 pp., 1 pl., 179 text-figs. Price $4.50. (London agents: Cambridge Univ. Press. Price 21*s.*)

Vol. 1 of this comprehensive treatise appeared in 1931 [M.A. **4**–483] and vol. 2 in 1932 [M.A. **5**–290]. Vol. 4, in two parts, is promised in 1937–38. The present volume deals with families 9–12, including alkali-syenites, syenites, monzonites, syenodiorites, gabbros and norites, with their extrusive and hypabyssal equivalents, in this order. But surely hypabyssal rocks are *intermediate* between plutonic and extrusive. 'Intermediate' in the title of the book evidently refers to the chemical composition, although the classification is a quantitative mineralogical one. The kinds of rocks in the systematic classification range from 'Orthosite TURNER (119 P)' to 'Harrisite HARKER (3412 H)'. '119 P' means a plutonite (i.e. plutonic rock) of family 9, order 1, class 1; and '3412 H' a hypabyssal rock of family 12, order 4, class 3. But in the head-lines to the pages we find 'Family 119 P' and 'Family 3412 H'; and in the table of contents 'Family 12' includes 'The diorite family' and 'The gabbro-norite family'. Like some rock names, 'family' here seems to have different limits. The text includes a large number of rock names, some obsolete and some new. The latter, as well as the system of notation, are not likely to be generally adopted. But the book will have a permanent value in tracing the history and changes in the meaning of rock names. In addition to detailed bibliographical references, a portrait of the author of a name is in many cases given. There are 47 such portraits in this volume, and in the three volumes a total of 92—an interesting portrait gallery of petrographers, interspersed with pictures of rock-sections.

L. J. S.

GROVES (A. W.). *Silicate analysis. A manual for geologists and chemists with chapters on check calculations and geochemical data.* With a foreword by A. HOLMES. London (T. Murby & Co.), 1937, xxii + 230 pp., 11 figs. Price 12*s.* 6*d.*

An excellent manual of rock analysis, with notes on the analysis of some of the more important silicate minerals. The methods are on the whole those of Washington and Hillebrand, but with numerous

small modifications, most (but in the reviewer's opinion, not all) o which are decided improvements. There are a few surprising erro and omissions, but these detract but little from the value of th book, which will be found useful by every analyst who has occasio to deal with rocks. M. H. H.

J. C. Poggendorff's biographisch-literarisches Handwörterbuch für Mathematik, Astronomie, Physik mit Geophysik, Chemie, Kristallograph und verwandte Wissensgebiete. Vol. 6, 1923–31; part 1, A–L Edited by Hans Stobbe. Berlin (Verlag Chemie), 1936, lxx + 696 pp. Price RM. 85 (foreign RM. 63·75) each part.

Johann Christian Poggendorff (1796–1877), the founder and edito of the well-known 'Annalen der Physik und Chemie' (usually know as 'Poggendorff's Annalen'), produced in 1863 a valuable work reference (vols. 1–2) giving biographical and bibliographical detai of workers in the exact sciences from the earliest times, so supplyin materials for the history of these sciences. The work has since bee carried on in a series of supplementary volumes: vol. 3 for th period 1858–83 (published in 1898), vol. 4 for 1883–1903 (1904 vol. 5 for 1904–22 (1925–26), and now vol. 6 for 1923–31. Vols. 1- were published by J. A. Barth of Leipzig. With vol. 5 the work compilation was taken over by the Saxon Academy of Sciences Leipzig with the co-operation of other German Academies, and issue by the Chemical Publishing Company of Berlin. Part 1 of vol. gives in alphabetical arrangement authors A–E, about 2500 number, and three more parts are promised in 1937 and 193 Crystallography is mentioned in the title, but many mineralogis and geologists are also included. A list of 3500 periodicals quot extends to 62 pages, and a long list of abbreviations includes seve that are not easily found elsewhere. This is an indispensable a international work for quick reference, but it is full of perso interests for casual browsing. Unfortunately the price is very high at the present rate of exchange, five guineas for each of the fo parts. L. J. S.

The mineral position of the British Empire. Imperial Institu London, 1937, 166 pp., 12 figs. Price 4*s*.

Simpson (J.). *Barium minerals.* Reports on the mineral indust of the British Empire and foreign countries. Mineral Resour Department, Imperial Institute, London, 1937, 2nd editio 84 pp. Price 2*s*.

BEARD (E. H.). *Strontium minerals.* Ibid., 1937, 2nd edition, 33 pp. Price 1*s.* 6*d.*

The first of these booklets is a new edition of 'A survey of the mineral position of the British Empire' (1931) which was based on statistics for the year 1928. This is now brought up to 1935 (including also some statistics for 1936) after a period of economic depression. Instructive and interesting tables and graphs compare the output of the more important minerals of the World and the Empire. The Empire is self-contained except for supplies of antimony, borates, molybdenum, petroleum, potash, pyrites, quicksilver, and sulphur. Under each country details are given of the occurrence and output of various minerals, with statistics of their exports and imports. The value of minerals produced in the Empire in 1935 totalled £396 million, 37 % of which was accounted by coal produced in the United Kingdom.

The other booklets are much enlarged editions of the brochures issued in 1921 and 1923 by the Imperial Mineral Resources Bureau and published by H.M. Stationery Office. These are now published by the Imperial Institute and issued in stiff covers. Much of the information and statistics is of course collected by team work, but this is the first occasion on which an author's name appears, an innovation that will be welcomed by bibliographers. [M.A. **1**–85, 3–493, **5**–59, **6**–292.] L. J. S.

New Minerals.

QUENSEL (Percy). *Minerals of the Varuträsk pegmatite. I. The lithium-manganese phosphates.* Geol. För. Förh. Stockholm, 1937, vol. 59, pp. 77–96, 2 figs. [Cf. M.A. **6**–440.]

Pegmatites at Varuträsk, 20 km. SE. of the Boliden mines in northern Sweden, have recently yielded many minerals of which the Li-Mn phosphates are now described. Triphylite when fresh is deep sky-blue (anal. I), $Li(Fe,Mn)PO_4$, altering to wine-yellow (II) and clove-brown (III). The optic axial plane is parallel to the cleavage (001) with $\gamma \perp$ the cleavage (010), 2V 26°, positive; but in some pieces showing polysynthetic twinning on (001) the extinction-angle a : (001) is 4°, suggesting that the mineral is not orthorhombic with the possibility of a clino-triphylite. Further alteration yields *ferri-sicklerite* (IV and V), $12RO.5Fe_2O_3.9P_2O_5$ or $(Li,Fe''',Mn'')PO_4$, which is dark brown and shows the cleavages of the original triphylite; $n > 1{\cdot}78$, not pleochroic. Still further oxidation gives

heterosite (VI from Varuträsk, VII from Erongo Mts., South-West Africa), $(Fe''',Mn''')PO_4$, which is black with purple streak and intense pleochroism (yellow-grey, red, and deep purple). These three minerals give different X-ray patterns, and they form a parallel series to lithiophilite → sicklerite → purpurite. The thin black coating on heterosite and purpurite represents a further stage of alteration; approximate analysis of this gave P_2O_5 31·2, Fe_2O_3 23·2, Mn_2O_3 29·1, H_2O 14·1 %. In another pair of parallel series sodium takes the place of lithium, but with a different ratio to that in natrophilite. *Varulite* (VIII), $Na_2O.5RO.2P_2O_5$ or $Na(Mn,Fe,Ca)_{2\cdot5}(PO_4)_2$, forms olive-green granular masses with good cleavages at 90° and the optic axial plane perpendicular to the better cleavage, 2V 70°, α 1·720, γ 1·732. Alluaudite (IX), $5R_3(PO_4)_2.Na(OH,F)$ or $(Na,Mn'',Fe''')PO_4$ is an alteration product of varulite; it is yellow or yellowish-green and radially fibrous with α 1·760, γ 1·775. Corresponding with varulite, but with iron predominating over manganese, is a mineral from South Dakota analysed by W. P. Headden in 1891; this is named *headdenite*.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
P_2O_5 ...	44·10	42·23	44·47	44·80	44·64	41·93	43·79	42·80	46·70
Fe_2O_3 ...	nil	0·33	6·30	27·20	29·08	27·44	33·42	8·35	19·83
FeO ...	24·33	22·85	18·21	0·59	0·22	—	—	7·52	—
Mn_2O_3 ...	—	—	—	nil	—	20·42	15·14	—	—
MnO ...	18·95	18·15	20·16	19·13	15·20	3·60	1·53	25·30	28·17
MgO ...	trace	0·11	nil	0·11	1·70	0·17	nil	nil	1·17
CaO ...	1·82	1·84	1·36	1·36	1·88	1·70	1·16	4·86	—
Na_2O ...	0·16	0·58	2·28	0·81	0·88	1·12	0·72	7·12	7·20
Li_2O ...	8·52	7·92	6·06	3·72	3·26	0·46	0·83	0·88	—
H_2O+ ...	0·31	0·36	0·64	0·51	0·44	1·65	2·33	0·75	0·66
H_2O- ...	0·29	0·13	0·05	0·51	0·79	1·67	1·08	0·14	0·24
Insol. ...	1·24	5·80	0·20	1·66	2·42	0·30	—	1·80	1·24
	99·72	100·30	99·73	100·40	100·51	100·46	100·00	100·06	100·03
Sp. gr. ...	3·423	3·384	3·521	3·391	3·271	3·409	3·398	3·581	3·576

VIII, also Al_2O_3 0·36, K_2O 0·12, F 0·06; IX, also F 0·80.

L. J. S.

QUENSEL (Percy), AHLBORG (Knut), & WESTGREN (Arne). *Minerals of the Varuträsk pegmatite. II. Allemontite. With an X-ray analysis of the mineral and of other arsenic-antimony alloys.* Geol. För. Förh. Stockholm, 1937, vol. 59, pp. 135–144, 4 figs.

QUENSEL (Percy). —— *III. Arsenostibite, a hydrous oxidation product of allemontite.* Ibid., pp. 145–149, 2 figs.

Quensel (Percy). —— *IV. Petalite and its alteration product, montmorillonite.* Ibid., pp. 150–156, 1 fig.

II. Allemontite occurs as tin-white lamellar masses and dendritic aggregates in the pegmatite (a new mode of occurrence of this mineral). Analysis of material (sp. gr. 6·384), which on polished sections shows a minute graphic intergrowth of two substances, gave Sb 73·9, As 25·4; homogeneous material gave Sb 61·5, As 35·0, together with small amounts of Bi, Fe, S. (Allemontite from ore veins contains more As than Sb.) Artificial alloys As–Sb form a continuous series with lattice constants ranging from a 4·123 Å., α 54·16°, V 42·8 Å^3. for As, to a 4·499 Å., α 57·02°, V 60·0 Å^3. for Sb. There is no evidence for a compound As Sb.

III. A yellow material coating the allemontite and penetrating along cleavages is optically isotropic with n 1·670–1·685. Analysis gave, after deducting admixed quartz and lepidolite, Sb_2O_5 55·2, As_2O_5 6·8, Sb_2O_3 5·2, As_2O_3 7·1, Bi_2O_3 0·4, Fe_2O_3 7·5, H_2O+ 8·0, H_2O- 9·8, corresponding with $3R_2O_3.5R_2O_5.25H_2O$ or (R_2O_3,R_2O_5) $5H_2O$. This seems to be identical with the arsenstibite of Adam, 1869, and it is named *arsenostibite.*

IV. Petalite is present in large amount as cleavage masses ½ m. long, associated with cleavelandite, spodumene, and amblygonite, in certain parts of the pegmatite. It is greyish-white with sp. gr. 2·418 (anal. I, by T. Berggren, $LiAlSi_4O_{10}$), and is often partly altered to pink montmorillonite with n 1·495 and low birefringence (anal. II, after deducting admixed petalite, $Al_2O_3.3SiO_2.6H_2O$). [Cf. Min. Mag. **20**–143.]

SiO_2.	Al_2O_3.	Fe_2O_3.	CaO.	Li_2O.	Na_2O.	K_2O.	H_2O+.	H_2O-.	F.
77·18	17·05	0·60	0·14	4·11	0·61	0·17	0·44	0·10	0·03
44·72	21·69	1·54	2·83	—	0·10	—	10·42	13·90	0·05

II, also MnO 0·19, MgO 4·54, P_2O_5 0·02.

L. J. S.

Vørlykke (Harald). *Scheteligite, a new mineral. Preliminary note.* Norsk Geol. Tidsskrift, 1937, vol. 17, pp. 47–49, 1 fig.

Small rough crystals of apparent orthorhombic habit were found with alvite, euxenite, monazite, thortveitite, native bismuth, &c., in pegmatite at Torvelona near Øvre Ljosland, Iveland, Norway. They are black with brilliant lustre and conchoidal fracture, and pale yellow to grey streak; sp. gr. 4·74, H. 5½, isotropic. Analysis gave TiO_2 18·73, Ta_2O_5 20, WO_3 5, Nb_2O_5 8·65, Sb_2O_3 7·77, Bi_2O_3 2·54,

Yt_2O_3 6·00, FeO 1·88, MnO 6·19, CaO 10·73, ign. 2·00, microclin 9·70 = 99·19; formula, $R_2(Ti,Ta,Nb,W)_2(O,OH)_7$. L. J. S.

Berman (Harry) & Gonyer (F. A.). *Roweite, a new mineral fro Franklin, New Jersey.* Amer. Min., 1937, vol. 22, pp. 301–30 1 fig.

A single small specimen shows a veinlet of roweite with franklinit willemite, zincite, and thomsonite (?). The imperfect light brow crystals are orthorhombic with cell dimensions a 8·27, b 9·01, c 6·6 ($a : b : c = 0·916 : 1 : 0·735$). Optic axial plane (001), $\alpha \perp$ (100 α 1·648, β 1·660, γ 1·663, 2V 15°, negative. Sp. gr. 2·92, H. 5; easil fusible to a black glass; soluble in HCl. Analysis, B_2O_3 32·4 MnO 28·30, MgO 1·66, ZnO 3·13, CaO 25·40, H_2O 8·51, inso 0·84 = 100·24. The unit cell contains four molecules $H_2(Mn,Mg,Zr$ $Ca(BO_3)_2$. The new mineral differs from sussexite $[H_2Mn_2(BO_3)_2]$ i containing calcium and in its optical properties. L. J. S.

Larsen (Esper S. *Jr.*). *Dakeite—a new uranium mineral fro Wyoming.* Mineralogist, Portland, Oregon, 1937, vol. 5, no. p. 7.

Larsen (Esper S. *Jr.*) & Gonyer (F. A.). *Dakeite, a new uraniu mineral from Wyoming.* Amer. Min., 1937, vol. 22, pp. 561–56

This occurs as small concretionary nodules in gypsite (a surfa efflorescence of gypsum mixed with some sand) near Wamsutte It is green-yellow and consists of an aggregate of flakes with perfe basal cleavage. Sp. gr. 2·51, H. 2½, α 1·489, β 1·542, γ 1·542, 2V 5 negative. It is slightly pleochroic, and in ultra-violet rays gives bright yellowish-green fluorescence. Analysis, CO_2 13·71, SO_3 9·6 UO_3 30·27, CaO 18·31, Na_2O 7·31, H_2O 19·95, insol. 1·06 = 100·2 agrees with $3CaCO_3.Na_2SO_4.UO_3.10H_2O$. The mineral is complete soluble in cold water, but is decomposed in hot water. L. J. S.

Hurlbut (Cornelius S. *Jr.*). *On synadelphite and plumbosynadelphit* Amer. Min., 1937, vol. 22, pp. 526–533, 3 figs.

A re-examination of allodelphite from Långban, Sweden [M. 4–496] proves its identity with synadelphite (H. Sjögren, 1884 The red-brown crystals are colourless inside with a red outer zon Goniometric measurements agree with orthorhombic symmetr $a : b : c = 0·5333 : 1 : 0·5851$; but double twinning and the optic orientation shown in sections point to triclinic symmetry; α 1·75 β 1·751, γ 1·761, 2V 37°, positive. A new analysis made on colou

less material gave As_2O_5 26·89, SiO_2 1·45, Al_2O_3 1·41, Fe_2O_3 0·86, MnO 53·10, MgO 4·62, CaO 1·55, Na_2O 0·62, K_2O 0·79, H_2O 8·52 = 99·81, sp. gr. 3·57, and the unit cell, of dimensions a 9·91, b 18·70, c 10·65 Å., contains $10[R_4''(AsO_4)(OH)_5]$. The red outer zone has α 1·851, β 1·864, γ 1·894, 2V 40°, positive, and contains As_2O_5 26·18, SiO_2 0·63, Fe_2O_3 0·48, MnO 52·27, PbO 3·24, MgO 5·89, CaO 1·25, Na_2O 0·59, K_2O 0·70, H_2O 8·74 = 99·97, sp. gr. 3·79; this variety is named *plumbosynadelphite*. L. J. S.

Yoshimura (Toyofumi). *On barium felspars from the Kaso mine, Tochigi prefecture, Japan.* (Japanese.) Journ. Geol. Soc. Japan, 1936, vol. 43, pp. 877–910, 19 figs.

A kind of barium-felspar was found as a gangue mineral associated with celsian and hyalophane. Prismatic crystals elongated in the direction of the c-axis reach a length of 1 cm. and show well-developed forms (110) and ($\bar{1}01$). Sp. gr. 3·003 at 16° C. Optical properties are similar to those of celsian, i.e. α 1·564, β 1·568, γ 1·572, optic axial plane (010), $a : c = 2–3°$ in acute axial angle β, 2V 80·5°, negative. Chemical analysis shows SiO_2 38·48, Al_2O_3 23·61, Fe_2O_3 0·60, MnO 2·67, MgO 0·97, CaO 0·85, BaO 25·50, K_2O 5·10, Na_2O 1·85, ign. 0·98 = 100·61. The presence of kaliophilite and nepheline molecules is inferred from the chemical composition, specific gravity and optical properties. The name *kasoite* is proposed for this mineral. R. O.

Dunn (J. A.) & Dey (A. K.). *Vanadium-bearing titaniferous iron-ores in Singhbhum and Mayurbhanj, India.* Trans. Mining Geol. Inst. India, 1937, vol. 31, pp. 117–184, discussion pp. 184–194, 3 pls.

Tipper (G. H.). *Vanadium-bearing magnetite deposits of Dhalbum and Mayurbhanj, Bihar, India.* Bull. Imp. Inst. London, 1936, vol. 34, pp. 449–452.

These ores occur as veins and lenses in gabbro. Analyses show Fe_2O_3 34·95–71·90, FeO 0–28·67, TiO_2 10·20–28·70, V_2O_3 0·59–3·80, &c. Under the microscope polished sections show magnetite, coulsonite, ilmenite, haematite, rutile, goethite, and lepidocrocite. *Coulsonite* (in the earlier account called vanado-magnetite) occurs as irregular light-grey patches in the magnetite. A micro-chemical test shows the presence of vanadium, and the composition is assumed to be $FeO.(Fe,V)_2O_3$. The origin and economic possibilities of the ores are discussed. L. J. S.

[Efremov (N. E.)] Ефремов (В. Е.) [i.e. Н. Е.]. Новый минерал из группы серпентин-хризотила [*sic*]. [*New mineral of the serpentine-chrysotile group.*] Труды Ломоносов. Инст. Геохим. Крист. Мин., Акад. Наук СССР (Trans. Lomonossov Inst. Geochem. Cryst. Min., Acad. Sci. USSR.), 1936, no. 7, pp. 351–352.

This greyish-brown asbestiform mineral with fibres 0·5–1 cm. long is from the Beden chromite deposit on the Great Laba river, northern Caucasus. Sp. gr. near 2·2, α 1·558, γ 1·562, positive. Two analyses, SiO_2 32·00 (33·53), Al_2O_3 2·30 (2·78), Fe_2O_3 1·90 (1·73), FeO 0·42 (trace) MgO 38·70 (41·11), CaO 4·56 (0·31), H_2O+ 18·03 (19·00), H_2O- 1·50 (1·80), total '99·81' (100·26), give the formula $2MgO.SiO_2.2H_2O$. L. J. S.

Bannister (F. A.) & Hey (Max H.). *The identity of penroseite and blockite.* Amer. Min., 1937, vol. 22, pp. 319–324, 3 figs.

X-ray photographs of penroseite [M.A. **3**–112] from Colquechaca, Bolivia, and of blockite [M.A. **6**–147] from Hiaco mine, near Colquechaca, both show the pyrite type of structure with a 6·00 Å. Polished sections show enclosed veinlets of naumannite (face-centred lattice, a 6·12 Å.), and this explains the variable amounts of Pb and Ag on which the distinction between penroseite and blockite was based. Micro-analyses (on 20 mg.), I penroseite, II and III blockite, show an excess of Se over the formula $(R,Ag_2)Se_2$.

	Se.	S.	Ni.	Co.	Fe.	Cu.	Hg.	Pb.	Ag.	Total.
I.	67·01	0·39	8·89	1·10	trace	4·50	1·45	13·72	2·13	99·19
II.	66·59	0·52	9·88	0·71	0·72	3·72	4·12	10·88	5·00	102·14
III.	67·31	trace	10·30	0·52	0·72	3·55	1·41	8·27	7·78	99·86

L. J. S.

Precious Stones.

Dudichné [= *Mrs.* Dudich] = Vendl (Mária) & Koch (Sándor). *A drágakövek különös tekintettel a mesterséges drágakövekre.* [Precious stones with special reference to artificial precious stones.] A Királyi Magyar Természettudományi Társulat, vol. 104, Budapest, 1935, vi + 468 pp., 25 pls., 26 text-figs. Price 15 pengős.

This handsome volume, published by the Royal Hungarian Natural Science Society, includes: I, General part (pp. 7–142) dealing with the history and uses of gemstones (pp. 7–67), physical and chemical characters, occurrences, and cutting; II, Special part (pp. 143–356) describing 65 minerals, also obsidian and moldavite; III, Artificial

manufactured) stones, imitations and counterfeits (pp. 357–418); V, Ornamental materials of organic origin (pp. 419–459). V. Z.

WILD (Georg O.). *Praktikum der Edelsteinkunde. Eine Einführung in das Wissen von den Edelsteinen.* Stuttgart (Franckh), 1936, 139 pp., 10 pls. (4 coloured), 44 text-figs. Price RM. 6·00 (bound 8·60).

This is a popular book written in easy German, but printed in German type. The short general part (34 pages) is followed by descriptions of the common gemstones, reference tables (8 pages), and a table of contents (in place of an index). The author, who is in charge of the Institut für Edelsteinforschung at the historic gem centre of Idar-Oberstein, has exceptional opportunities of knowing trade conditions and the sources of supply of rough material; and he has done much research work on the cause of the colour and the changes of colour in gemstones. In the descriptive portion special prominence is given to quartz varieties, 25 pages being devoted to these as against 2 pages for ruby and sapphire (apart from 5 pages on manufactured corundum and spinel). The four coloured plates, showing rough and cut stones, are very attractive. The rather diagrammatic text-figures, including several sketch-maps showing distribution, suffer from over-reduction. L. J. S.

MACALLIEN (W. J.). *Scottish gem stones.* London & Glasgow (Blackie & Son), 1937, vii + 120 pp., 1 pl., 36 text-figs. Price 2*s.* 6*d.*

This little book, offered at a low price, affords an excellent introduction to the study of minerals and geology, presented from a standpoint that will appeal to a wider circle of readers. The gem minerals dealt with include diamond, jet, sapphire, beryl, topaz, zircon, tourmaline, kyanite, garnet, serpentine, quartz varieties, and opal; but few of these are really of gem quality, a point that has not been sufficiently emphasized. The coloured plate shows some specimens that certainly were not found in Scotland. Lists of localities for these minerals are quoted from M. F. Heddle's 'Mineralogy of Scotland', and some useful sketch-maps are given. The account of diamond is based on the very doubtful record of John Smith (1896) from the graphite in the Craigman coal mine in Ayrshire; and no attempt has been made to confirm this. Smith wrote: 'When the graphite is reduced to a fine powder, and examined by the microscope

in a good light, some of the dust particles are seen to emit brig flashes as if they were on fire '—not a really reliable test for diamon L. J. S.

The National Association of Goldsmiths of Great Britain & Ireland Ye book, 1936–1937, Precious gems issue. London (Heywood & Co [1936], 164 pp. Price 2*s.* 6*d.*

Forty pages contain a series of short articles dealing with ge stones from various aspects by a number of authors. The remaind gives particulars of the Association and of the Gemmological Assoc tion, but just half (83 pages) of the booklet is occupied by tra advertisements. L. J. S.

Ball (Sydney H.). *A historical study of precious stone valuation a prices.* Econ. Geol., 1935, vol. 30, pp. 630–642, 2 figs. Reprint in Gemmologist, London, 1936, vol. 6, pp. 7–12, 40–45, 1 fig Historical notes on the variation in values with changing fashio L. J. S.

[Shubnikov (A. V.)] Шубников (А. В.). Новый „квадрант" д огранки драгоценных камней.—Chubnikov (A.). *Nouveau type „quadrant" pour facetter les pierres précieuses.* Труд. Ломонос Инст. Акад. Наук СССР (Trav. Inst. Lomonossoff, Acad. S URSS), 1936, no. 8, pp. 95–99 (Russian), p. 100 (French résum 6 figs.

The stone is cemented at the end of a long rod which passes p pendicularly through the centre of a six- or eight-sided plate. Wh the plate rests on each edge in turn with the stone on the grindi lap, a series of (6 or 8) facets is cut at the same inclination; the r is then clamped in another position with r pect to the plate a another set of facets ground at another angle. L. J. S.

Maier (Wilhelm). *Brillanz geschliffener Edelsteine.* Neues Jah Min., Abt. A, 1936, Beil.-Bd. 71, pp. 458–491, 3 pls., 12 text-fi

The brilliancy of faceted gemstones is separated into: (1) surf brilliancy or lustre, depending on the refractive index and degree polish; (2) inner brilliancy, from rays that have passed into the sto and reflected from the back facets; (3) spectral brilliancy, due dispersion; and (4) scintillation brilliancy, seen when a stone w many facets is slightly moved. From a brilliant-cut stone, with crown facets, 1056 reflected and refracted rays, some of them due two or more internal reflections, are theoretically possible. Many these are mapped and identified by receiving the images given b

parallel beam of light on to a cylindrical screen. Reflected and refracted rays are distinguished by coating the facets with a fluorescent pigment. The tracks of the rays may be rendered visible by enclosing the stone in a glass smoke chamber. The prismatic relations producing spectral brilliancy are worked out for different forms of cutting.

L. J. S.

TIPPER (G. H.). *Indian gemstones.* The Asiatic Review, London, 1936, n. ser., vol. 32, pp. 335–341.

Brief mention is made of diamond, sapphire from Kashmir, ruby from Burma (mentioned by Varthema, 1496), aquamarine, jadeite from Burma, various forms of quartz from the Deccan traps, garnet from Jaipur, lapis-lazuli from the ruby mines district of Burma. Bored beads of quartz varieties and of lapis-lazuli have been found at Mohenjo-Daro in Sind (3000 B.C.)

L. J. S.

KAPLAN (Lazare). *Cutting the Jonker diamond.* Nat. Hist. (Amer Mus. Nat. Hist.), 1936, vol. 38, pp. 227–236, 19 figs.

The 'Jonker' diamond, a clear stone of 726 carats found by Jacobus Jonker in January 1934 in the Elandsfontein alluvial diggings on a tributary of the Pienaars river near the Premier diamond mine in the Transvaal, has been cleaved into three pieces and sawn for the grinding of twelve gems. [Later reports give the total weight of eleven step-cut (the largest 143 carats) and one marquise as 375 carats; yield 51·7 %.]

L. J. S.

DITTLER (E.) & REIßNER (R.). *Die Mikroanalyse des Diamanten.* Zentr. Min., Abt. A, 1936, pp. 97–101, 1 fig.

Small (2–5 mm.) octahedra, said to have been produced artificially (no details given), have d 3·49–3·54, n 2·41–2·42, and lattice dimension a 3·55–3·58, agreeing with diamond. Micro-analysis of opaque black material (1·2 mg.) gave C 98·28 % and ash 0·83 % (Fe_2O_3 with trace of SiO_2 ?). Transparent rose-red material gave C 99·83 %.

L. J. S.

BARRER (Richard M.). *Sorption processes on diamond and graphite. Part I. Reactions with hydrogen.* Journ. Chem. Soc. London, 1936, pp. 1256–1261, 4 figs.

—— —— *Part II. Reactions of diamond with oxygen, carbon dioxide, and carbon monoxide.* Ibid., pp. 1261–1268, 6 figs.

Diamond at 400° C. chemisorbs hydrogen more vigorously than does graphite. Oxygen is chemisorbed by diamond at 0 – 144°, at

244 – 370° CO_2 is liberated, and at higher temperatures the oxide film decomposed to CO_2 and CO. L. J. S.

George (W. H.). *Surface markings on a diamond.* Nature, London, 1936, vol. 138, pp. 616 and 641, 1 fig.

The octahedral faces of a crystal of diamond from Sierra Leone, free from triangular markings at ordinary magnifications, revealed triangular markings of 'mosaic dimensions' 0·001 mm. when photographed slightly out of focus at a magnification of 750 diameters. These markings were found only in groups and at the edges of the crystal face; they have not yet been detected on any other crystal of diamond. F. A. B.

Lindley (Henry W.). *Wachstumserscheinungen am Diamant.* Fortschr. Min. Krist. Petr., 1937, vol. 21, pp. 71–72.

Many yellow diamonds from South-West Africa show a zonal banding parallel to the octahedral faces, the several layers differing in birefringence and sometimes also in their fluorescence under ultra-violet rays. They also often show a division into six or eight sectors ('pyramids of growth') divided by the octahedral or cube planes along which there are minute inclusions. Crystals showing a strong pale-blue fluorescence are more transparent than others for ultra-violet rays. L. J. S.

Robertson (*Sir* Robert), Fox (J. J.), & Martin (A. E.). *Further work on two types of diamond.* Proc. Roy. Soc. London, Ser. A, 1936, vol. 157, pp. 579–593, 1 pl., 9 text-figs. [Cf. M.A. **6**–6.]

The photoelectric properties were tested down to – 253° C., but there is no appreciable effect below – 100° C. The infra-red emission spectra when diamonds are heated to 400° C. show a band at 8 μ with those of type 1, but not with type 2, and a band at 4·8 μ with both and also with graphite. At 700° C. in air the surface becomes covered with minute triangular etchings; and at about 1400° C. in an inert atmosphere a coating of graphite is formed. The specific heat (0·0033 at – 181° C., and 0·142 at 54° C.) is the same for the two types. L. J. S.

Junner (N. R.). *The Bonsa diamondfield, Gold Coast Colony.* Bull. Imp. Inst., London, 1936, vol. 34, pp. 373–374.

Diamond was discovered in 1922 in the Bonsa river gravels near Tarkwa [about 100 miles SW. of the first discovery in the Colony.

.A. 1–16]. It has since been found in several tributary streams, ıd has been worked by the natives since 1933, the monthly output ɾeraging about 6000 carats. The stones are small (40 to the carat), ually brown or green, and mostly bort. The country-rock is ainly conglomerate with some volcanic rocks. Associated minerals the gravels are staurolite, limonite, tourmaline, zircon, kyanite, nenite, magnetite, rutile, gold, and occasionally corundum (sapphire) d pleonaste. L. J. S.

NNER (N. R.). *Gisements alluvionnaires de diamant de la Gold Coast.* Congr. Internat. Mines Métall. Géol. Appl. Session VII, Paris 1935, Sect. Géol. Appl., vol. 1, pp. 179–185, 2 figs.

WETSCH (Georg). *Geologische Beobachtungen an Diamantlagerstätten der Goldküste, Westafrika.* Zeits. Prakt. Geol., 1936, vol. 44, pp. 167–174, 2 figs.

General accounts of the occurrence of diamond in alluvial deposits, sed on the Reports of the Geological Survey of the Gold Coast. -16; **3**–28, 128; **5**–399.] L. J. S.

LBERMINZ (V. A.) & BONSTEDT (E. M.). *On the diamond from the new deposit in the Syuren river basin (the Bashkir ASSR).* Compt. Rend. (Doklady) Acad. Sci. URSS, 1936, vol. 3 (12), pp. 329–331, 2 figs.

A single crystal of diamond was found in 1935 in gold washings ssand near Shkaroda village on the Great Syuren river, southern als [about 52½° N., 56½° E.]. It weighs 0·2390 gram and is clear h a slight yellowish tinge and minute black inclusions: sp. gr. 94. The rounded octahedral form gives a continuous band of ected light between (111) and (110). This is the nineteenth ality reported for diamond in the Urals. L. J. S.

PENHEIM (Victor). *Sedimentos diamantiferos do Paraná.* Avulso, Serviço de Fomento da Producção Mineral, Brasil, 1936, no. 9, 15 pp., 8 pls.

collected account is given of the occurrence of small diamonds he State of Paraná along the tributaries of the Tibagy and Cinzas rs (lat. 24° S.). They are found mostly in pot-holes and rifts in rivers and in cascalho; and have been derived from glacial con-merates of Permian age, and primarily from acid rocks of the

Assunguy series (Algonkian). Associated minerals are anatase, tourmaline, agate, jasper, &c. L. J. S.

Blank (Eugene W.). *Diamond finds in the United States.* Rocks and Minerals, Peeskill, N.Y., 1934, vol. 9, pp. 147–150, 163–166, 179–182; 1935, vol. 10, pp. 7–10, 23–26, 39–40, 5 figs.

The available information is collected with many references to the literature. Apart from the diamonds mined in peridotite at Murfreesboro in Arkansas [M.A. **2**–233, 525], isolated finds have been made, usually in gold washings, in many of the States. Three fairly well-defined regions are noted: (1) the Pacific coast, mainly in California west of the Sierra Nevada; (2) in glacial drift in the northern States from Wisconsin to Ohio, and presumably derived from a source in Canada; (3) east of the Appalachian Mts. from Virginia to Alabama. The Arkansas mines are not now worked. Other peridotite occurrences are listed, though they have yielded no diamond. L. J. S.

Islamov (I. I.) & Tolmačev (J. M.). *On the colour of corundum.* Compt. Rend. (Doklady) Acad. Sci. URSS, 1936, n. ser., vol. 1, pp. 11–13.

Spectroscopic analysis of corundum from Semiz-Bugu, north Kazakhstan, gave the following percentages:

Colour.	Cr.	Ti.	V.	Ga.
Brownish-red ...	0·18	0·01	0·04	0·005
Blue	0·002	0·2	trace	0·005
Light grey ...	trace	0·03	trace	0·002

from which it is concluded that the red colour is due to chromium and the blue to titanium. Fe, Na, Ca, Sr, Mg, Be, Mn, Ni, Cu, Si, Si are also present. L. J. S.

Schröder (Alfred). *Die isomorphe Schichtung am Korund und ihre Bedeutung für die Unterscheidung natürlicher von synthetischen Korunden.* Zentr. Min., Abt. A, 1936, pp. 129–135, 6 figs.

Some tabular crystals of sapphire from Siam show prominent blue and grey zoning parallel to the hexagonal bipyramids $(22\bar{4}1)$ and $(8.8.\bar{1}6.3)$. Chance sections of such crystals would give any angle from 0° to 90° of optical extinction to the banding. It has been stated that the zoning of native corundum is always parallel to the prism faces (in which case the extinction would always be straight) and that this affords a means of distinguishing between native and artificial corundum. L. J. S.

Dollar (A. T. J.). *Growth features in synthetic ruby and sapphire.* Trans. Edinburgh Geol. Soc., 1936, vol. 13, pp. 385–387.

Certain 'boules', particularly of sapphire, of arrested growth and suddenly cooled show bundles of micro-columnar microlites. This structure disappears under the annealing process. Some 'boules' show a rhythmic alternation of darker thick layers and lighter thin layers.

L. J. S.

Espig (H.). *Der synthetische Smaragd.* Zeits. Krist., 1935, vol. 92, pp. 387–391, 6 figs.

Jaeger [M.] & Espig [H.]. *Der synthetische Smaragd.* Deutsche Goldschmiede-Zeitung, 1935, vol. 38, pp. 347–349.

Many attempts have been made since 1848 to make artificial emerald. Success has been obtained at last by Jaeger and Espig, the synthetic product ('igmerald') consisting of hexagonal prisms with base, two centimetres long, yielding cut stones up to a carat in weight very similar to the natural mineral. The crystals show a zonal structure and contain minute liquid cavities with bubbles. The method of manufacture is not disclosed. [M.A. **6**–200.]

H. H.

Schiebold (E.). *Vergleichende Untersuchungen an natürlichen und synthetischen Smaragdkristallen.* Zeits. Krist., 1935, vol. 92, pp. 435–473, 9 figs.

Artificial emerald was compared with the natural mineral and found to be essentially identical with it in spite of minor differences. The synthetic crystals are chemically purer ($Be_3Al_2Si_6O_{18}$ with traces of Fe and Cr), have a slightly lower specific gravity, a less pronounced cleavage parallel to the base, and lower refractive indices, besides showing slight differences in habit and internal structure.

H. H.

Böse (Robert). *Optische und spektrographische Untersuchungen an Beryllen, insbesondere bei höheren Temperaturen.* Neues Jahrb. Min., Abt. A, 1936, Beil.-Bd. 70, pp. 467–570, 6 pls., 16 text-figs.; Dissertation, Hamburg, 1936.

A large amount of valuable optical data is given for beryls of various types from several localities. The refractive indices, birefringence, and dispersion show an increase with the density. Extreme values are for an almost colourless aquamarine from Spitzkopje, South-West Africa, d 2·660, ω 1·56715, ϵ 1·56301 (Na), and for light

rose morganite from Madagascar d 2·877, ω 1·60011, ϵ 1·59195. Optical data are also given for temperatures up to 1150° C. (ω and ϵ increasing with the temperature), and for different portions of crystals showing zonal growths. The coefficients of expansion were determined from angular measurements of a cut prism. At 1200° C. the crystals break down with evolution of gases (H, H_2O, CO_2, and in one case He) and metallic sublimates of Fe, Ni, Mn, Cu, Ag, Ga, Ti, Ge, Na, Mg, Zn. Spectroscopic analysis of beryls showed the presence of Li, K, Cs, Ca, Sc, V, Cr, Sn in addition to the elements noted above. L. J. S.

Holstein (O.). *Über die Beryll- und Smaragdbestimmung mit Hilfe der Lupe „Universal".* Zentr. Min., Abt. A, 1936, pp. 26–28. Translation: *Identifying the emerald.* Gemmologist, London, 1936, vol. 5, pp. 157–159.

The 'universal' gem lens with colour filters made by E. Leitz enables emerald (coloured by chromium) to be at once distinguished from aquamarine (coloured by iron). Emeralds from different localities show slight differences when viewed through the colour filters. L. J. S.

Chudoba (K.). *Durch Sonnenlicht verfärbbare Zirkone (Hyazinthe).* Deutsche Goldschmiede-Zeitung, 1935, vol. 38, pp. 303–304.

—— *Bemerkenswerte Farbänderung an Zirkonen (Hyazinthen) durch Erhitzung.* Ibid., pp. 474–475.

Chudoba (K.) & Dreisch (T.). *Farbänderung und Absorption des Zircons von Mongka, Hinterindien.* Zentr. Min., Abt. A, 1936, pp. 65–79, 2 figs.

Rose-red crystals of zircon (hyacinth) from Mongka [Cambodia, French Indo-China] on exposure to sunlight immediately change to a grey or greyish-brown colour. The colour is restored by heating to 100° C. or by exposure to radium, and keeping in the dark. At 260° C. the crystals are decolorized. Spectra in the ultra-violet, visible rays, and infra-red show an absorption band at 0·8 μ, suggesting the presence of a ferric compound. L. J. S.

Chudoba (K.). *Die Licht- und Doppelbrechung der a-Zirkone.* Zentr. Min., Abt. A, 1935, pp. 362–367, 3 figs.

A greenish-brown, optically uniaxial a-zircon from Ceylon gave d 4·150, ω_{Na} 1·8629, ϵ_{Na} 1·8739. Section plates show, by differences in the birefringence, a zonal intergrowth of a-zircon and b-zircon with some c-zircon. L. J. S.

Chudoba (K.) & Stackelberg (M. v.). *Dichte und Struktur des Zirkons.* Zeits. Krist., 1936, vol. 95, pp. 230–246, 12 figs.

S. Stevanović (1903) divided zircons into *a*-zircon of density 3·9 to 4·0, uniaxial with slight birefringence; *b*-zircon of density 4·69 to 4·71, uniaxial with strong birefringence; *c*-zircon of density 4·0 to 4·69, biaxial. It was found that heating to 1450° C. changed *a*- and *c*-zircon into normal *b*-zircon, and that the structure of all three varieties was essentially the same, but that the lighter the zircon the more the structure was distorted. The lighter zircons probably contain a large amount of impurity, which is largely amorphous in the case of the *a*-zircon. [Cf. Min. Mag. **14**–48.] H. H.

Eppler (W. F.). *Das Geheimnis des Zirkons.* Deutsche Goldschmiede-Zeitung, 1936, vol. 39, pp. 531–534, 4 figs.

The locality of the blue gem zircons, usually said to be Siamese, was visited by the author in 1927–8. It is in the Mongka district [14° N., 107° E.] near the NE. border of Cambodia in French Indo-China. The principal village in the district is Bo-Ko-Noi. Brown-red and colourless zircons are found in the gravels of the Hoi-Lawué stream, a tributary of the Sé San. The stones as mined are sent to Bangkok for heat treatment in charcoal furnaces (without the addition of chemicals, as has been stated). The brown-red stones in a reducing atmosphere at 900–1000° C. change to blue, blue-grey, or colourless; while in an oxidizing atmosphere at 850–900° C. they change to yellow, reddish-yellow, or colourless. L. J. S.

Kennard (T. G.) & Howell (David H.). *Spectrographic examination of Siamese zircons.* Amer. Min., 1936, vol. 21, pp. 721–726.

Brown, blue, and colourless zircons, said to be from 'Annam, French Indo-China', all showed a very small amount of hafnium and traces of Ba and Ca. Traces of Mg, Na, Ag are present in some, but these cannot account for the difference in colour. Inclusions are richer in iron. The silver sometimes found is perhaps due to an artificial chemical treatment for changing the colour. L. J. S.

Lenzer (G.). *Über Amethyste vom Brandberg in Deutsch-Südwestafrika.* Zentr. Min., Abt. A, 1936, pp. 289–290.

Crystals of amethyst from this locality are deep violet in colour and of good gem quality. They show the forms *m r z s x M* [Dana's letters]. The colour is not uniform, being darker in the centre of the crystals, and at times almost colourless in the outer portion.

L. J. S.

Leonardos (Othon Henry). *Quartzo roseo no Brasil.* Avulso, Serviço de Fomento da Producção Mineral, Brasil, 1936, no. 11, pp. 4–10.

Rose-quartz is known in several districts in Brazil. It belongs to the late stage in the crystallization of pegmatite veins injected into Archaean rocks. The best material comes from the Jequitinhonha-Arassuahy district, and is exported for carving at prices of £100 to £120 per metric ton. L. J. S.

Moraes (Luciano Jacques de). *Quartzo no norte de Minas Geraes.* Avulso, Serviço de Fomento da Producção Mineral, Brasil, 1936, no. 11, pp. 11–16, 1 fig.

Rock-crystal is collected from pegmatite-veins and as water-worn crystals in the streams. The richest deposits are in the Serra do Cabral, Serra Mineira, and Serra Itacambira. Localities are also mentioned for amethyst and citrine. L. J. S.

Special agate number. Rocks and Minerals, Peekskill, N.Y., 1936, vol. 11, no. 9 (whole no. 63), pp. 131–200, figs.

A series of popular articles by several authors, with special reference to American occurrences. L. J. S.

Tuček (Karel). *Příspěvek k novým názorům na vznik achátu.* [Note on the new theories of the formation of agate.] Věda Přírodní, Praha, 1935, vol. 16, pp. 290–291.

Both coloured and uncoloured agates are abundant near Nova Paka in north-east Bohemia. The presence of pigment does not appear to be necessary for the formation of agate, as suggested by Liesegang. Climatic changes appear to be of more importance, as suggested by Heinz and Linck [M.A. **4**–295]. F. S.

[Godlevsky (M. N.).] Годлевский (М. Н.). Авантюрин Большого Таганая.—Codlevsky [sic] (M. N.). *Avanturin der Lagerstätte "Bolschoi Taganai".* Зап. Всеросс. Мин. Общ. (Mém. Soc. Russe Min.), 1934, ser. 2, vol. 63, pp. 58–66, 3 figs. (Russian with German summary.)

The avanturine-quartzite of Bolshoy Taganay in the Urals is found in zones bordering joint-planes in quartzite bands interbedded with schists. The characteristic appearance of avanturine is due to the presence of films of colloidal iron oxides (probably derived from the oxidation of pyrite) coating the grains of quartz and the flakes of muscovite. Certain varieties also contain flaky chlorite (delessite ?). S. I. T.

Lengyel (*vitéz* Endre). *Jáspis-változatok a Tokaj-Hegyaljáról.*—Lengyel (E.). *Jaspisvarietäten vom Tokaj-Hegyalja-Gebirge.* Földtani Közlöny, Budapest, 1936, vol. 66, pp. 129–147, 2 pls., 1 text-fig. (map). (German.)

The jaspers and quartz-rocks of this region occur almost always as veins along tectonic lines and usually at the contact of rhyolites and andesites. Those in the rhyolites are white or pale-coloured, whilst those in the andesites are darker (red, brown, black). It is supposed that they have been derived from opal of hydrothermal origin, which with dehydration and recrystallization passed through the stages: opal → cacholong → chalcedony → quartzine → quartz. Detailed petrographical descriptions are given of the several varieties consisting of opal, chalcedony, quartz, and metallic oxide pigments.

V. Z.

Howard (Joseph W.). *Opals.* Journ. Chem. Education (Amer. Chem. Soc.), 1936, vol. 13, pp. 553–556, 9 figs.

A general article, with views of some opal mines. L. J. S.

Bányai (János). *A Hargita déli részének opál-lerakódásairól.*—Bányai (J.). *Die Opalablagerungen des südlichen Hargita-Gebirges.* Mat. Term.-tud. Értesítő, Budapest, 1933, vol. 49, pp. 196–201, 3 figs. (Hung.), pp. 202–203 (Germ.).

The colour of the coffee-brown bands in the opal from the abandoned iron mine near Bodvaj in Transylvania is due to inclusions of limonite, crystals of magnetite, and probably psilomelane. V. Z.

Anderson (B. W.) & Payne (C. J.). *An unusual scapolite catseye.* Gemmologist, London, 1934, vol. 3, pp. 180–181.

A cabochon-cut stone (20·42 carats) of unknown locality (but believed to be from Burma) is violet-blue with strong dichroism (dark blue and pale lavender), optically uniaxial, ω 1·560, ϵ 1·544, sp. gr. 2·634. It shows rod-like cavities and a cleavage parallel to the optic axis. The absorption spectrum suggests the presence of chromium. L. J. S.

Turner (F. J.). *Geological investigations of the nephrites, serpentines, and related "greenstones" used by the Maoris of Otago and south Canterbury.* Trans. Roy. Soc. New Zealand, 1935, vol. 65, pp. 187–210.

Petrographical descriptions are given of a number of different types grading from non-schistose and schistose nephrites through seminephrites to tremolite-schists. The typical nephrite consists of

an interfelted mass of fine fibres of tremolite, with accessory chlorite, serpentine, talc, sphene, garnet, chromite, &c. These nephritic rocks appear in many cases to have been derived from hornblendites, and perhaps also from peridotites and pyroxenites exposed near Lake Wakatipu and the Olivine Range. Other 'greenstones' are to be classed as serpentine (antigorite and bowenite), and less often as talc-schist. L. J. S.

Rimann (Eberhard). *Nephrit und Asbest von Paakila, Finnland.* Zentr. Min., Abt. A, 1936, pp. 321–327, 353–368, 1 fig.

Anthophyllitic nephrite consisting of a felt of fine fibres of anthophyllite forms with little talc and serpentine a 6–7 cm. vein in 'asbestos-rock'. Sp. gr. 2·83–2·87, H. 3–4, γ 1·616–1·64; analysis I by G. Grosser. It is dark grey-olive, and takes a good polish. The dark-coloured 'asbestos-rock' consists of fibrous prisms up to 8 cm. long of anthophyllite-asbestos (sp. gr. 2·94–3·00, α 1·605, γ 1·619–1·626, anal. II) in a matrix of serpentine. Both analyses agree with $H_2(Mg,Fe)_7Si_8O_{24}$, with about 90 % of the Mg molecule. The asbestos-rock has been formed by the hydrothermal alteration of enstatite-rich dunite and enstatitite near a granite contact.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	H_2O+.	H_2O-.	Total.
I.	58·74	0·02	0·12	0·66	5·61	0·06	29·95	4·59	0·24	99·99
II.	58·43	trace	0·10	0·72	6·84	0·12	29·66	3·76	0·16	99·79

I and II, also traces CaO, Na_2O, K_2O.

L. J. S.

Willems (H. W. V.). *Astridiet, een chroomrijk gesteente van Nieuw-Guinea.* [Astridite, a chrome-rich precious stone from New Guinea.] De Ingenieur in Nederlandsch-Indië, 1934, vol. 1, part 4 (Mijnbouw en Geologie), pp. 120–121.

A loose block found at Manokwari, and perhaps transported from Humboldt Bay, Dutch New Guinea, is dark green with lighter coloured to white veins, and it takes a good polish. As an ornamental or semi-precious stone it is named after the late Queen of Belgium. It consists mainly of a fine felted mass of fibres of chrome-rich jadeite intergrown with picotite, quartz, opal, and limonite; and it has perhaps been derived from an olivine-rock. The jadeite fibres extinguish at 7–8° (α) to their length; pleochroism, α yellowish-green, $\perp \alpha$ bluish-green. Analysis of the rock gave SiO_2 48·10, TiO_2 0·08, Al_2O_3 5·25, Cr_2O_3 19·20, Fe_2O_3 6·48, FeO 0·80, MnO 0·13, MgO 6·63, CaO 0·23, BaO 0·06, Na_2O 10·86, K_2O 0·30, CO_2 0·08, S 0·01, H_2O+ 1·28, H_2O- 0·28 = 99·77; sp. gr. 3·351. L. J. S.

BUDDHUE (John [Davis]). *Mexican amber.* Rocks and Minerals, Peekskill, N.Y., 1935, vol. 10, pp. 170–171.

An amber from Baja (Lower) California, Mexico, is mostly clear nd of a fine yellow colour, but sometimes osseous and nearly white. p. gr. 1·05, H. 2½. It contains a little succinic acid, and is only lightly soluble in the solvents that attack Baltic amber. In ultra-iolet rays it shows a pale blue fluorescence on fresh surfaces. It is amed bacalite from the locality. L. J. S.

Colour of Minerals.

EE (O. Ivan). *A new property of matter: reversible photosensitivity in hackmanite from Bancroft, Ontario.* Amer. Min., 1936, vol. 21, pp. 764–776, 1 fig.

Pink sodalite (var. hackmanite) from near Bancroft [M.A. **3**–118] cquires a deeper red or violet colour when exposed to ultra-violet ys (2250–4800 Å.); it also fluoresces salmon-pink and phosphoresces y-blue. The induced colour fades slowly in the dark and quickly exposure to light. This change in colour is possibly due to the esence of manganese (0·001 %). Spectroscopic analysis shows also , Ga (0·01 %), Pb, Nd, Be, Ba, Sr. Commercial titanium dioxide quires a cream colour in sunlight, fading again to white in the rk. A reversible change in colour on heating (' reversible thermo-sitivity ') is shown by HgI_2, $CaCrO_4$, gillespite, [ZnO], &c.

L. J. S.

OHLER (Nora M.). *A spectrophotometric study of smoky quartz.* Amer. Min., 1936, vol. 21, pp. 258–263, 4 figs. [Cf. M.A. **5**–123.]

Absorption curves for wave-lengths 700 to 200 $\mu\mu$ are given for moky-quartz before and after being decolorized by heating at 0° C. Such decolorized smoky-quartz, rock-crystal, and silica-glass quire a smoky colour on exposure to radium, and they then give sorption curves similar to that of natural smoky-quartz. Calcula-ns of the change of energy due to the transfer of an electron from oxygen to a silicon ion correspond to the amounts of energy indi-ted by the positions of the absorption bands. L. J. S.

ENNARD (T. G.), HOWELL (David H.), & YAECKEL (M. P.). *Spectro-graphic examination of colorless and blue halite.* Amer. Min., 1937, vol. 22, pp. 65–67.

Colourless rock-salt with a blue zone, from Stassfurt, gave in both rtions Na, Ca, Al, Li, K, Si, Ti, Mg, Sr, Ba. The colour is there-e structural rather than pigmental. L. J. S.

Lorenz (Hermann). *Absorptionen und Farben in Alkalihalogenid-kristallen.* Fortschr. Min. Krist. Petr., 1936, vol. 20, pp. 290-323, 5 figs.

A review of the literature on the absorption spectra of visible and ultra-violet rays in alkali haloids, and the changes in absorption and colour produced by the presence of various impurities and by the action of heat, pressure, and various radiations, with special reference to blue rock-salt and similar cases. L. J. S.

Beutel (E.) & Kutzelnigg (A.). *Änderung der Farbe und Entwicklung des Gefüges einiger Mineralien durch Wärmebehandlung.* Mitt. Wien. Min. Gesell., no. 100, for 1935 *in*: Min. Petr. Mitt. (Tschermak), 1936, vol. 47, pp. 397–400, 3 figs.

Polished slabs of alabaster (containing organic matter) from Bosnia when heated at 120° C., onyx-marble (containing some $FeCO_3$) at 500° C., massive aragonite from Transylvania at 300° C., and chalybite and ankerite at 500° C. are improved in colour, and the banded, veined, and cloud-like markings are brought out more clearly.

L. J. S.

Kołaczkowska (Marja). *Zmiana barwy w barycie pod wpływem promieni Röntgena.—Le changement de couleur dans la barytine sous l'influence des rayons X.* Arch. Min. Tow. Nauk. Warsaw (Arch. Min. Soc. Sci. Varsovie), 1936, vol. 12, pp. 181–185, 1 fig. (Polish), p. 186 (French résumé).

Specimens of colourless, transparent baryte from Příbram, Bohemia, become bright blue when irradiated by X-rays, show a distinct pleochroism (α deep blue, β pale green, γ very pale blue), and blacken a photographic plate. On exposure to sunlight for 15 to 20 minutes the irradiated baryte loses its colour again and also its power of blackening a photographic plate. F. A. B.

Topographical Mineralogy.

Zambonini (Ferruccio) [1880–1932]. *Mineralogia Vesuviana.* 2nd edition by Emanuele Quercigh. Napoli, 1935, 463 pp., 98 figs. (Supplement to Atti R. Accad. Sci. fis. mat. Napoli, 1935, ser. 2, vol. 20.) Price unbound 200 lire.

The first edition of this famous work on Vesuvian minerals was published in 1910 and an appendix in 1912. Zambonini was engaged on the second edition when he died in 1932 at the early age of 51

[Min. Mag. **23**–362; M.A. **5**–269]. Signor Quercigh is to be congratulated on incorporating results published up to 1934 without altering the scope and format of the work and without adding more than 44 pages to the first edition and appendix. The increased bulk is due more to the use of a thicker paper. Although no attempt is made to incorporate crystal-structure data with the general description of each species, X-ray work on Vesuvian material is sometimes mentioned (e.g. cancrinite, davyne, and kaliophilite, but not nepheline or the scapolite group). F. A. B.

Rondolino (Rinaldo). *I minerali di Piampaludo nel "Gruppo di Voltri"*. Periodico Min. Roma, 1936, vol. 7, pp. 193–206.

The following minerals occur in lenses of garnet-rock in serpentine, prasinite, and amphibolite, in Piedmont. Garnet, as red-brown crystals with the forms (110), (211), and new (11.5.5); n_{Na} 1·8089; anal. I, 66·31 % grossular. Chlorite (clinochlore), green plates with bluish opaline reflections; forms *c i z* κ *v* [Dana's letters]; β 1·577, 2V 29° 42′; anal. II, $5(Mg,Fe'')O.(Al,Fe''')_2O_3.3SiO_2.4H_2O$. Epidote, yellowish-green, granular and poor crystals; β 1·7432, 2V 87° 44′, $c : c = -1° 30'$; anal. III, $H_2R''_4R'''_6Si_5O_{24}$ with lower Si than usual. Sphene, as white to pale green crystals, *c n z* κ; sp. gr. 3·441. Octahedra of magnetite occur only in the amphibolite.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MgO.	CaO.	H_2O+.	Total.	Sp. gr.
I.	36·18	1·19	18·86	10·18	3·38	—	30·48	—	100·27	3·698
II.	30·60	—	16·80	2·18	5·02	32·18	trace	12·76	99·54	2·730
III.	35·01	—	29·36	8·29	1·55	trace	24·75	2·03	100·99	3·376

L. J. S.

Garrido (J.). *Notas sobre mineralogia española. Cerusitas cristalizadas*. Bol. Soc. Española Hist. Nat., 1934, vol. 34, pp. 301–326, 33 figs.

Crystals of cerussite from fifteen Spanish localities are described. The frequencies of the 34 crystal-forms are noted and compared with those of other localities. L. J. S.

Mário de Jesus (Amílcar), with Viana (A.) and Cavaca (Rogério). *Minerais de Portugal continental*. Comunicações Serv. Geol. Portugal, 1930, vol. 16, pp. 51–152, 73 [+1] figs. on plates and in text.

Vol. 16, issued as a single part of this periodical, bears the date 1927 on the title-page and 1930 on the wrapper, but copies were not

received in libraries until 1934. The preface to the paper is dated 1928. The paper was issued separately in two parts, dated 1928 and 1930 on the wrappers, but without any indication of the periodical from which they are reprints. [M.A. **5**–269.] L. J. S.

Meixner (Heinz). *Neue Mineralfunde in den österreichischen Ostalpen. II.* Mitt. Naturwiss. Ver. Steiermark, 1930, vol. 67, pp. 138–149.

—— —— *III.* Ibid., 1931, vol. 68, pp. 146–156.

—— —— *IV.* Ibid., 1932, vol. 69, pp. 54–58.

—— —— *V.* Carinthia II, Mitt. Ver. Naturkund. Landesmus. Kärnten, 1934, vol. 123–124, pp. 16–18.

—— —— *VI.* Mitt. Naturwiss. Ver. Steiermark, 1935, vol. 72, pp. 61–66.

—— —— *VII.* Mitt. Landesmus. Joanneum, Abt. Bergbau, Geol., Graz, 1937, Heft 1, pp. —.

—— —— *VIII.* Mitt. Naturwiss. Ver. Steiermark, 1936, vol. 73, pp. 108–117.

A series of 82 numbered notes on the minerals of various localities in Styria, Carinthia, Tirol, &c. [M.A. **5**–270; **6**–355.] L. J. S.

Weiss (L.). *Neue Mineralfunde aus dem Habachtal.* Mitt. Wien. Min. Gesell., 1936, no. 101, *in* Min. Petr. Mitt. (Tschermak), 1936, vol. 48, pp. 289–291.

New finds of minerals (beryl, sphene, chabazite, prehnite, laumontite, &c.) in the Habach valley, Salzburg, are described. [M.A. **5**–488, **6**–355.] L. J. S.

Bobková (Božena). *Příspěvky ku krystalografii moravského barytu.—Beiträge zur Kristallographie des mährischen Barytes.* Spisy vydávané přírodovědeckou fakultou Masarykovy University (Publ. Fac. Sci. Univ. Masaryk), Brno, 1935, no. 211, 15 pp., 5 figs.

—— *O některých barytech moravských.* [On some Moravian barytes.] Ibid., 1936, no. 225, 14 pp., 4 figs. (Czech with German summary.)

Baryte crystals of the wolnyn habit occurring in porous concretions from Rudice near Brno show in different combinations the forms *c a b β λ η m N n χ o d v q f r R z y* [Dana's letters]. Similar crystals from Lažánky near Rudice are poorer in forms. Crystals in cavities in limonite from Květín near Mohelnice are elongated along the *a*-axis and tabular on (001) with *o b m a y λ*. Tabular and macrodomatic crystals from galena-blende veins at Jasenice show *c d m o z a λ u r f*.

Crystals from several other localities are also described. The brachydomatic habit (with *o* predominating) is rare, and is found in concretions in Miocene clays at Královo Pole and Ivančice near Brno. Crystals of macrodomatic habit (*d u c*) terminated only by *b*, from the Coal Measures at Rosice, have a perfect (010) cleavage (like those earlier described by F. Slavík from the Coal Measures of Kladno, Bohemia).

F. S.

Nováček (Radim). *Několik poznámek k mineralogii Písecka.* [Some remarks on the mineralogy of the Písek district.] Věda Přírodní, Praha, 1936, vol. 17, pp. 228–230, 1 pl.

The mineral hitherto mentioned as nigrine from the pegmatite at Údraž proves to be strüverite with about 35 % $(Ta,Nb)_2O_5$. Most crystals are elongated in the direction of a polar edge of (111), and twins on (101) are frequent. In garnets from the pegmatites at Písek and Výrec the spessartine molecule predominates over the almandine molecule. The písekite of A. Krejčí [M.A. **2**–335] appears to be a variety of ampangabeite, and is certainly not, as was supposed, a metamict pseudomorph after monazite. Monazite crystals without any trace of alteration have been found together with písekite.

F. S.

Ulrich (František). *Ryzí bismut z Dobšiné.* [Native bismuth from Dobšiná.] Věda Přírodní, Praha, 1936, vol. 17, pp. 233–235, 2 pls.

Native bismuth, a new mineral for the Slovakian Ore Mts., penetrates veinlets and cleavage cracks in chalybite. It is often twinned on $(01\bar{1}2)$.

F. S.

Urkart (Ed.). *Barytové morfolity na Moravě.* [Baryte concretions of Moravia.] Příroda, Brno, 1936, vol. 29, pp. 218–220.

Baryte concretions, similar to the well-known Bologna stone, have been found at Biskoupky in association with magnesite and sepiolite. At other localities in central Moravia the mineral occurs in Miocene clays.

F. S.

Vilata (Florian). *Albit od Bobrůvky* (*u Vel. Meziříčí*) *a od Písku* („*u Obrázku*"). [Albite from Bobrůvka and from Písek.] Příroda, Brno, 1936, vol. 29, pp. 229–233.

Measurements on the Fedorov stage of albite in pegmatite from Bobrůvka, western Moravia, gave α 1·529, β 1·533, 2V 80°, corresponding with $Ab_{95}An_5$. Albite in an aplitic rock from Písek, Bohemia, gave α 1·530, β 1·532, corresponding with $Ab_{94}An_6$.

F. S.

Brückl (Karl). *Die Minerallagerstätten von Ostafghanistan. Versuc einer Gliederung nach genetischen Gesichtspunkten.* Neues Jahrl Min., Abt. A, 1936, Beil.-Bd. 72, pp. 1–97, 7 pls., 19 text-figs.

The mineral deposits at various localities are described in ord according to a genetic classification. Those of ruby at Jagdalak an of lapis-lazuli at Serr-i-Sang in the upper Kokcha valley, Badaksha are described in some detail and are classed as perimagmatic (pne matolytic contact-metamorphic) in crystalline limestone. The tex figures are of crystals of plagioclase from a dike of weathered basa at Tschel-Setun and of ruby. L. J. S.

Harada (Zyunpéi). *Chemische Analysenresultate von japanische Mineralien.* Journ. Fac. Sci. Hokkaido Univ., Sapporo, Ser. 1936, vol. 3, pp. 221–362.

A collection of 764 chemical analyses (23 not previously publishe of 140 species of Japanese minerals, giving the localities and referenc to the literature. The new analyses are of galena, blende, pyrit spinel, calcite, grossular, olivine, zircon, yamagutilite, topaz, andal site, gadolinite, heulandite, laumontite, and aquacreptite.

L. J. S.

The mineral resources of the Union of South Africa. With a summa of the mineral resources of South West Africa. Compiled in th office of the Geological Survey, Pretoria (Dept. of Mines 1936, xiv + 454 pp., 7 pls., 66 text-figs. Price 1*s.*

This useful volume (25 × 18 cm.), sold at a nominal price, w prepared for the Empire Exhibition held in Johannesburg in 193 It is a revision of that issued in 1930 for the Empire Mining a Metallurgical Congress in South Africa. It is not merely an exhib tion catalogue, but is full of detailed and reliable information, a is in fact a valuable text-book. A useful summary is given of th physical features and geology of South Africa, with coloured physic and geological maps (1 : 7,500,000), and there are other maps showi the distribution of various minerals. References to the more im portant literature are given under each heading, as well as statisti and graphs of production. Mention is made of some quite ra minerals, e.g. muromontite from near Messina. The briefer accou of the minerals of South-West Africa is supplementary to that give by P. A. Wagner in 1916 [M.A. **1**–238]. L. J. S.

KRENKEL (E.). *Geologie Afrikas.* Geologie der Erde, Berlin (Borntraeger), 1934, part 3, first half, pp. i–viii, 1003–1304, 2 pl., 50 text-figs.

The first part of this section on Africa appeared in 1925 and the second in 1928. The first half of the third part describes the geology of Angola, the Congo Basin, and parts of Central Africa, including Northern Rhodesia. Of special interest to mineralogists will be brief notes on diamonds from Angola, the lead-zinc ores of Broken Hill, the geology of the copper belt in Northern Rhodesia and in the Congo, and the uranium minerals of Chinkolobwe, Katanga. Many analyses of igneous rocks are quoted. There is a list of the most important publications arranged alphabetically under regions.

W. C. S.

WILLEMSE (J.). *On the ore-minerals of the Murchison Range, the Cam and Motor mine (Gatooma) and the Globe and Phoenix mine (Que Que).* Trans. Geol. Soc. South Africa, 1936, vol. 38 (for 1935), pp. 41–55, 3 pls., 1 text-fig.

A description of material collected mostly from old mine dumps. The following minerals are described:—native gold, native antimony, stibnite, pyrrhotine, pyrite, arsenopyrite, chalcopyrite, chalcosine, zinc-blende, covellite, calaverite, wolfsbergite, jamesonite, tennantite, enargite, famatinite, rutile, ilmenite, and iron oxides. Of these species the less common ones were recognized only by means of the ore-microscope, and some of the identifications are not at all certain.

S. J. S.

JÉRÉMINE (*M^me* E.). *Sur un nouveau gisement de saphirine.* Bull. Soc. Franç. Min., 1936, vol. 59, pp. 347–348.

An enclosure of biotite-schist in pegmatite from the south of Marignisandougou, Guinea, contains hypersthene, zircon, spinel, plagioclase, and sapphirine, the last a new mineral for West Africa.

F. A. B.

FERRAZ (Luiz Caetano). *Compendio dos mineraes do Brasil em fórma de diccionario. Contendo a descripção completa de todos os minierios e mineraes até esta data encontrados no Brasil—America do Sul.* Rio de Janeiro (Impresa Nacional), 1928 (1929 on wrapper), x + 645 pp., many plates.

This is a collected account of the mineralogy of Brazil, and it appears to be the first complete account to be published. Details

of the characters, chemical analyses, and occurrences of all the minerals and ores known from Brazil are given in an alphabetical arrangement. Further details arranged under States are given in a 'Secçã historica', which also includes long extracts from earlier publications. There is a good gazetteer of mineral localities and a bibliography. The numerous (poorly printed) plates give views, maps, and photographs of mineral specimens in the author's collection; and the frontispiece gives a portrait of Henrique Gorceix [1842–1919], the first director of the School of Mines at Ouro Preto.

L. J. S.

Geological Survey of British Guiana. 1934 Reports. Georgetown, 1936, viii + 76 pp., 7 maps and sections. Price $3·00.

Williams (Gordon J.). *The geology and gold deposits of the Potaro.* With petrographical appendix by D. R. Grantham. Geol. Surv. Brit. Guiana, 1936, iv + 62 pp., 1 map, 2 pls. Price 72 *c.*

Bracewell (S.). *Geology and gold deposits of the Konawaruk, 1935.* Ibid., 1936, iv + 20 pp., 2 pls. Price 12 *c.*

The new Survey, instituted in 1933, has made rapid surveys over a wide area in difficult country in the goldfields of the interior of the Colony. Gold is found to be associated with schistose acid volcanic rocks and granites, especially near the junction of the two. The view of J. B. Harrison that the alluvial gold was derived from diabase is rejected. No source of the alluvial diamonds found in many of the same districts is suggested. L. J. S.

Pseudomorphs.

Pelíšek (Josef). *Zvětrávání tremolitu v mastek v krystalických vápencích severozápadní Moravy.* [Alteration of tremolite to talc in the crystalline limestones of NW. Moravia.] Příroda, Brno, 1935, vol. 28, pp. 115–118.

Tremolite (anal. I) as columnar aggregates in crystalline limestone at Petrov, near Kunštát, is altered to talc; II of the intermediate product, and III of the secondary talc.

	SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MgO.	CaO.	H_2O.	Total.
I.	57·20	0·33	—	0·64	26·12	13·23	1·59	99·11
II.	58·03	1·89	1·31	—	27·48	5·83	4·69	99·23
III.	58·58	3·00	2·13	—	29·35	0·52	5·38	98·96

F. S.

ARoš (Zdeněk). *Příspěvek k otázce původu pseudomorfos v dolnoborských pegmatitech.* [Contribution to the question of the origin of the pseudomorphs in the pegmatites of Dolní Bory, Moravia.] Věda Přírodní, Praha, 1936, vol. 17, pp. 160–164, 1 pl.

The pseudomorphs consist of muscovite with some biotite and chlorite; they are hexagonal or pseudo-hexagonal and either prismatic or acute-pyramidal in form. The original mineral of the prismatic forms is tourmaline or cordierite, remnants of which have been found on microscopical examination. The pyramidal pseudomorphs, though similar to corundum in form, are after tourmaline.

F. S.

CHWARTZ (G. M.). *Alteration of spodumene to kaolinite in the Etta mine.* Amer. Journ. Sci., 1937, ser. 5, vol. 33, pp. 303–307, 1 fig.

In a part recently opened up in the Etta mine, South Dakota, the large spodumene crystals are in part or completely altered to kaolin (instead of to 'killinite', M.A. **3**–215), preserving the outline and cleavage of the original mineral. Analysis shows a loss of Li_2O and SiO_2 and gain of H_2O, with a porosity of about 5 %. L. J. S.

ERRITT (C. A.). *"Castellated dolomites" from Major County, Oklahoma.* Amer. Min., 1936, vol. 21, pp. 604–607, 3 figs.

In a thin band of dolomite rock in Permian shales near Sherman there are found low square pyramids consisting of minute crystals of dolomite with quartz and clay. These are impressions of hopper-shaped crystals of halite. L. J. S.

EHLMAN (Robert S.). *Quartz paramorphs after tridymite and cristobalite.* Amer. Min., 1935, vol. 20, pp. 808–810, 2 figs.

Vesicles in Miocene volcanic rocks (quartz-latite) near Red Mountain, Ouray, Colorado, contain minute plates of quartz pseudomorphous after tridymite, and minute rosettes of quartz probably after cristobalite. L. J. S.

RDOCH (Joseph). *Silica-fluorite pseudomorphs.* Amer. Min., 1936, vol. 21, pp. 18–32, 8 figs.

Miocene sandstone at Santa Monica Mts., Los Angeles Co., California, is fissured by a basalt intrusion and veined with quartz. The quartz veins contain in places pseudomorphs of quartz and chalcedony after small cubes of fluorite. These sometimes consist

of a few grains of quartz, and are then transparent; but more often they consist of a fine granular aggregate of quartz or feathery chalcedony, with an outer zone of chalcedony in which the fibres are normal to the faces of the cube. There is often a later deposit of chalcedony giving rounded edges, and also a final deposit of drusy quartz on the surface. The chalcedony gives an X-ray pattern identical with that of quartz. L. J. S.

Vatan (André). *Spongilles et gypse silicifié dans l'Éocène supérieur du Berry.* Compt. Rend. Acad. Sci. Paris, 1935, vol. 201, pp. 1402–1404.

At various places in western Cher pebbles and buhrstones occur consisting of skeletal crystals of gypsum more or less silicified; also in some places lenticular masses of similar composition, approximating to opalite. Their nature points to an origin in a lake or lagoon in an arid climate. C. A. S.

Growth and Corrosion of Crystals.

Stockbarger (Donald C.). *The production of large single crystals of lithium fluoride.* Rev. Sci. Instruments (Amer. Inst. Physics), 1936, n. ser., vol. 7, pp. 133–136, 3 figs.

By using pure reagents and a special furnace technique, lithium fluoride crystals of optical quality can be grown up to three inches in diameter at the rate of one millimetre per hour. F. A. B.

Rix (Walter). *Über Kristallisation im elektrischen Feld.* Zeits. Krist. 1937, vol. 96, pp. 155–181, 13 figs.

The author investigated the density of germs (centres of crystallization) in salol and sulphur, including the effect on this density of an electric field. Such germs only appear when kernels (foreign bodies) are present, though only very few of these serve as inoculators. In the absence of kernels it is possible to keep substances liquid for indefinite periods at temperatures as far below freezing point as desired. If they are present, an electric field of 1500 volts per cm. doubles the number of germs, but has no effect on the habit of the crystals. The explanation is given of the fact that, when a difference of electric potential is applied to a non-conducting solution or melt, the liquid rotates, most of it moving towards the cathode, but a thin upper layer moving towards the anode, where alone crystals are deposited. H. H.

Ernst (E.). *Beitrag zur Frage der Abhängigkeit der Verschiebungsgeschwindigkeiten der Flächen eines wachsenden Kristalles von seinen Begrenzungselementen.* Zeits. Krist., 1937, vol. 96, pp. 38–77, 16 figs.

The rates of growth of four rock-salt spheres were measured perpendicular to the faces (110), (210), (111), (001) under carefully controlled conditions of the temperature, &c., of the solution in which they were immersed. H. H.

Anscheles (J. M.). *Wachstum von Kristallen auf Kosten von neben denselben enstehenden Keimen.* Zeits. Krist., 1936, vol. 95, pp. 150–156.

As arguments in support of Fedorov's hypothesis of crystal growth at the expense of neighbouring particles are brought forward Miers's experiments on the growth of crystal faces on the goniometer, &c. Fedorov's theory is defended against criticisms in A. V. Shubnikov's recent book 'How crystals grow' [M.A. **6**–267]. H. H.

Seifert (H.). *Über regelmäßige Verwachsungen und anomale Mischkristalle im System $KClO_3$–$KMnO_4$ und über ihre Bedeutung für die allgemeine Theorie solcher Verwachsungen.* Zeits. Krist., 1937, vol. 96, pp. 111–149, 13 figs.

Observations were made of regular growths of potassium permanganate on potassium chlorate, and an explanation is given of the results on structural and kinetic lines. Experimental investigation was undertaken of anomalous mixed crystals of the two substances. Similar phenomena were observed for $KClO_3$ and other salts of the type ABX_4, such as $BaSO_4$. H. H.

Sanguli (A.). *Note on adsorption and abnormal properties of crystals.* Zeits. Krist., 1937, vol. 96, pp. 225–227.

An enumeration of eleven different peculiarities of crystals which may be caused by adsorption of impurities. H. H.

Müller (Horst Guido). *Zur Natur der Rekristallisationsvorgänge. I. Einkornrekristallisation an verformten Einkristallen.* Zeits. Physik, 1935, vol. 96, pp. 279–306, 19 figs.

—— —— *II. Untersuchungen an Rekristallisations-Einkristallen.* Ibid., pp. 307–320, 9 figs.

—— —— *III. Versuche an Steinsalz-Preßkörpern.* Ibid., pp. 321–327, 3 figs.

An experimental study of the conditions of recrystallization of pressure-deformed rock-salt. Cubic cleavages of the artificial and

naturally occurring mineral from Hallein, Salzburg, were employed. A difference in the transparency of the deformed material and the newly formed crystal permits the velocity of recrystallization to be measured at various temperatures. Lattice defects in recrystallized rock-salt were also investigated and the breaking strength shown to be dependent on temperature and duration of annealing as in the case of metals. F. A. B.

Erdey-Grúz (T.). *Über das elektrolytische Wachstum der Metallkristalle. I. Wachstum von Silberkristallen aus wässerigen Lösungen.* Zeits. Physikal. Chem., Abt. A, 1935, vol. 172, pp. 157–187, 34 figs.

By making a single-crystal sphere of silver the cathode in a suitable electrolyte, and using a very low current density, large crystals of silver bounded by plane faces can be prepared. The forms developed vary with the solution used, but not with the current density. Departures in the lists of observed forms from the list predicted by the Kossel-Stranski theory of crystal growth are explained by adsorption effects. Current density over-voltage curves indicate that in some cases the discharge rate of the ions is the growth-velocity determining factor, in others the rate of diffusion, and in others the rate of nucleus formation. M. H. H.

Polessitsky (A.). *Die Verteilung geringer Substanzmengen zwischen flüssiger und fester kristallinischer Phase. I. Verteilung des Bariumnitrats zwischen gesättigter wässeriger Lösung und Kristallen von Bleinitrat.* Zeits. Physikal. Chem., 1933, Abt. A, vol. 167, pp. 394–398, 2 figs.

The partition of small amounts of barium nitrate between lead nitrate crystals and a saturated solution of the latter follows the Nernst partition law; the partition coefficient [Ba in crystals]/[Ba in solution] is 26 at 0° C., 20 at 25° C., and 13 in a boiling solution. M. H. H.

Polessitsky (A.). *Die Verteilung geringer Substanzmengen zwischen flüssiger und fester kristallinischer Phase. II. Die Verteilung des Bariumnitrats zwischen der gesättigten wässerigen Lösung und den Kristallen von Strontiumnitrat.* Zeits. Physikal. Chem., Abt. A, 1935, vol. 172, pp. 300–303, 1 fig.

The partition of small additions of barium nitrate between a saturated solution of strontium nitrate and crystals of $Sr(NO_3)_2$ has been examined. The Nernst partition law is followed, the partition

coefficient being 7·9 at 35° C. and 4·2 at 100° C., a rate of decrease much less than that of the ratio of the solubilities of $Sr(NO_3)_2$ and $Ba(NO_3)_2$. The latter ratio is evidently not a controlling factor in the partition. M. H. H.

Miles (F. D.). *The formation and constitution of crystals of lead salts containing water-soluble colloid.* Phil. Trans. Roy. Soc. London, Ser. A, 1936, vol. 235, pp. 125–164, 2 pls., 7 text-figs. [Preprint issued 1935.]

Crystals of $PbCl_2$, $PbBr_2$, $2PbBr_2.H_2O$, PbI_2, and PbN_6 (α and β lead azide) [M.A. **5**–113] were grown from solutions containing dextrine or gelatine at various concentrations and temperatures. The colloid enters into the crystals to the extent of 5–8 %, and has no influence on the crystal habit, and it may determine the formation of a hydrate or one or other modification of the substance. Small amounts of the colloid can be absorbed by crystals already formed. X-ray examination shows that the lattice dimensions are not changed. The crystal consists of a skeletal growth of crystallites with layers of colloid in between. L. J. S.

Kummel (Hans) & Kleber (Willi). *Ätzversuche an Konkavkörpern. II. Teil: Versuche an Hohlhalbkugeln (auf c und d) und an anderen Konkavkörpern des Fluorit.* Neues Jahrb. Min., Abt. A, 1935, Beil.-Bd. 70, pp. 49–64, 6 pls., 9 text-figs. [Cf. M.A. **6**–272.]

Concave spherical surfaces bored on the (100) and (110) faces of fluorite, hollow cylinders parallel to [100] and [110], and sunken faces and edges were etched with HNO_3 and HCl, and the etch-figures and light-figures obtained are described in detail. L. J. S.

Aubert (Paul). *Modifications du faciès des cristaux d'acide urique par les matières colorantes ajoutées à l'eau mère.* Compt. Rend. Acad. Sci. Paris, 1936, vol. 202, pp. 1192–1194.

The modifications in crystal-form of uric acid caused by small additions (1–2/10000) of fuchsine, neutral red, methylene blue, viranine, and Bismarck brown are described. Those caused by the first four (elongation along the *a*-axis) differ from that caused by fuchsine (elongation along the *b*-axis). Neutral red also affects the cleavage. All form solid solutions and the coloured crystals fluoresce in ultra-violet light. C. A. S.

Royer (Louis). *De l'influence de la symétrie du milieu sur la symétrie des figures de corrosion dans les cristaux ; nouveaux exemples.* Compt. Rend. Acad. Sci. Paris, 1936, vol. 202, pp. 1346–1348.

The effect of certain active organic acids (e.g. malic and tartaric) on various hemihedral crystals (blende, zincite, scolecite, cuprite, apatite, scheelite, and wulfenite) has been examined. With all except apatite and wulfenite corrosion took the form of indefinite striae, but with these two the etch-figures resulting from the action of the active acids differ definitely from those formed by the inactive. The sensitive faces are those which have as sole element of symmetry a plane of symmetry perpendicular to their direction, e.g. the prism faces of apatite. In other cases the dissymmetry is only apparent on comparing a face and its parallel, as the two base faces of wulfenite.

C. A. S.

Royer (Louis). *De l'orientation des cristaux de fluoborate de potassium par le mica et la barytine et des cristaux de sulfite de sodium par le mica.* Compt. Rend. Acad. Sci. Paris, 1936, vol. 203, pp. 1687–1689.

When KBF_4 crystallizes on a fresh flake of mica it is oriented thereby in the same way as $KMnO_4$, $KClO_4$, or NH_4ClO_4. $BaCrO_4$ probably behaves in similar fashion. On baryte KBF_4 is oriented so that faces of the same notation coincide. Anhydrous Na_2SO_4 has one dimension of its unit cell (5·44 Å.) approximately the same as one of mica (5·12 Å.), and it is therefore also oriented when crystallizing thereon.

C. A. S.

Watanabé (Shinroku) & Watanabé (Atsushi). *Morphological and optical studies of acetylsalicylic acid.* Proc. Imp. Acad. Tokyo, 1935, vol. 11, pp. 379–380, 3 figs.

Kôzu (Shukusuké) & Takané (Katsutoshi). *Cell-dimensions and space-group of acetylsalicylic acid.* Ibid., pp. 381–382.

Acetylsalicylic acid (aspirin) supplied by different makers varies in crystal habit, being prismatic in the direction of the *a* or *b* axis or tabular on (001). Recrystallized from methyl alcohol at room temperature, the crystals are mostly prismatic in the direction of the *a*-axis, whilst at 50–60° C. the habit is tabular on (001) with elongation along the *b*-axis. Goniometric measurements gave $a : b : c = 1{\cdot}7120 : 1 : 1{\cdot}6809$, $\beta = 84° 33'$. Optic axial plane $\perp$ (010); $a : c = +45–46°$, α 1·502, β 1·640, γ 1·652, $2V$ 30° 30′; sp. gr. 1·3. X-ray measurements give the cell dimensions *a* 11·36, *b* 13·2

c 22·30 Å. ($a:b:c = 0·859:1:1·687$), β 86°, the unit cell containing fifteen molecules $C_9H_8O_4$. The space-group is C_{2h}^2 or C_2^2. L. J. S.

Himmelbauer (A.). *Orientierte Verwachsung in Mineralreiche.* Mitt. Wien. Min. Gesell., no. 100, for 1935 *in*: Min. Petr. Mitt. (Tschermak), 1936, vol. 47, pp. 387–389.

Several examples of epitaxy are mentioned; new are: cerussite on tarnowitzite from Tsumeb, South-West Africa; linnaeite on chalcopyrite from Victoria mine, Littfeld, Westphalia; galena on millerite from Reichensteinerberg, Hesse; and linnaeite on millerite. L. J. S.

[Grigoriev (D. P.)] Григорьев (Д. П.). О деформациях кристаллов в некоторых искусственных и естественных силикатных сплавах.—Grigorjev (D. P.). *Über Kristalldeformationen in einigen künstlichen und natürlichen Silikatschmelzen.* Зап. Всеросс. Мин. Общ. (Mém. Soc. Russe Min.), 1936, ser. 2, vol. 65, pp. 69–72, 1 pl. (Russian with German summary.)

Deformed crystals of various minerals in rocks and artificial melts are described, and the terms 'protoplastic deformations' and 'protoplastic structures' are suggested for fractureless deformations and structures. S. I. T.

Frondel (Clifford). *Twisted crystals of pyrite and smoky quartz.* Amer. Mus. Novitates, 1936, no. 829, 6 pp., 6 figs.

Composite cubes of pyrite are common at French Creek, Chester Co., Pennsylvania. Some of them show a twist about the triad axes, the twist being in opposite directions about adjacent axes. This habit of the crystals is perhaps related to the presence in them of cobalt and arsenic. Smoky-quartz from St. Gotthard, Switzerland, shows a twist about a dyad axis, and from El Paso Co., Colorado, about the triad axis. Since twisted crystals are not known in the rock-crystal and amethyst varieties of quartz, it is suggested that the twisting in smoky-quartz has some relation to the colouring matter. L. J. S.

Frondel (Clifford). *Oriented inclusions of tourmaline in muscovite.* Amer. Min., 1936, vol 21, pp. 777–799, 2 figs.

The tourmaline crystals are mostly flattened on $(11\bar{2}0)$, some on $(10\bar{1}0)$, (0001), &c., and they usually show a definite orientation with respect to the percussion-figures of the mica. L. J. S.

Frondel (Clifford) & Ashby (George E.). *Oriented inclusions of magnetite and hematite in muscovite.* Amer. Min., 1937, vol. 22, pp. 104–121, 19 figs.

Magnetite crystals are flattened on (111) and usually show hexagonal outlines, but are sometimes much elongated; they show cracks parallel to (111) and to the percussion-figure of the mica. Haematite flattened on (0001) is usually as dendritic growths. L. J. S.

Radioactivity.

Henderson (G. H.), Mushkat (C. M.), & Crawford (D. P.). *A quantitative study of pleochroic haloes. III—Thorium.* Proc. Roy. Soc. London, Ser. A, 1937, vol. 158, pp. 199–211, 2 pls., 3 text-figs. [Cf. M.A. **6**–35.]

Thorium haloes are much rarer than those due to uranium. The best were seen in biotite from Star Lake, Manitoba, and a few from Pierrepont, New York. Five rings due to α-particles of the thorium family are recorded with the halo photometer. L. J. S.

Stark (M.). *Pleochroitische (Radioaktive) Höfe, ihre Verbreitung in den Gesteinen und Veränderlichkeit.* Chemie der Erde, 1936, vol. 10, pp. 566–630, 2 pls.

The minerals composing rocks of all kinds and of different geological ages were examined for pleochroic haloes. These are not always present, and they are affected by changes in the rocks. They do not afford a reliable indication of the age of a rock, but they do give some idea of the distribution of radioactive elements.

L. J. S.

Starik (I. E.). *Studies of the "lead method" for measuring geologic time and its application to the determination of chlopinite from Khlok, Transbaikalia.* Rep. Internat. Geol. Congress, XVI (1933), U.S.A., 1936, vol. 1, pp. 217–224.

Translation of previous papers [M.A. **6**–258]. From the Pb/(U + Th) ratio the age of khlopinite is calculated as 182×10^6 years, and from the He/(U – Th) ratio as 127×10^6 years. L. J. S.

Pelloux (A.). *I minerali uraniferi e le sorgenti di acque radioattive della miniera di Lurisia presso Roccaforte di Mondovì.* Atti Soc. Ligustica Sci. Lett. Genova, 1934, vol. 13, pp. 137–170, 3 pls., 4 text-figs.

A detailed account is given of the occurrence of uranium minerals and of radioactive mineral springs in the schistose rocks (besimaudite)

of this locality in Piedmont. Autunite crystals show the forms *c u e l b a m*, and are twinned on (110); sp. gr. 3·18, β 1·5767, γ 1·5773 (Na), 2E 44°. Torbernite crystals (*c e a*) have sp. gr. 3·7, ω 1·6204 (Na); analysis by R. Bruna gave P_2O_5 13·43, As_2O_5 2·83, UO_3 58·77, CuO 11·39, H_2O 13·55 = 99·97. Regular intergrowths of autunite and torbernite are described. L. J. S.

GLEDITSCH (Ellen) & FÖYN (Ernst). *The period of radium.* Amer. Journ. Sci., 1935, ser. 5, vol. 29, pp. 253–259.

From the rate of growth of radon in ionium solutions prepared from three samples of bröggerite from Karlshus, Norway, and of unaltered uraninite from Spruce Pine, North Carolina, the period of radium is calculated as 1686 years. For slightly altered cleveite from Austagdar, Norway, the result is 1666 years. L. J. S.

HECHT (Friedrich) & KROUPA (Edith). *Die Bedeutung der quantitativen Mikroanalyse radioaktiver Mineralien für die geologische Zeitmessung.* Zeits. Anal. Chem., 1936, vol. 106, pp. 82–103.

Detailed micro-analyses, made on 20–40 mg. of pure material selected from single crystals, are given of ten uraninites from various localities, also of thorianite, monazite, and allanite. The results of the Pb/(U + 0·36 Th) ratio agree with those of macro-analyses. L. J. S.

ALTER (Chester M.) & KIPP (Egbert M.). *The variation of the lead-uranium-thorium ratio of a single crystal of Wilberforce, Ontario, uraninite.* Amer. Journ. Sci., 1936, ser. 5, vol. 32, pp. 120–128.

Successive layers from a single crystal (2 × 1 × 1 cm.) of uraninite were dissolved in HNO_3 and the following determinations made. The outer layer was brown, and uranium had already been leached from it; but the inside material was black and pure, and from this the age and 'k factor' are calculated. [Cf. M.A. **5**–132.]

	Pb.	U.	Th.	$\frac{Pb}{U+0{\cdot}36\,Th}$
Outside ...	9·739 %	37·848 %	8·360 %	0·2383
Middle ...	11·927	58·475	14·093	0·1877
Core ...	11·865	60·699	8·051	0·1866

L. J. S.

BRUNER (Frank H.). *Uraninite from Hottah Lake.* Amer. Min., 1936, vol. 21, pp. 265–266.

Analysis of material from this new locality [south of Great Bear Lake, Canada] gave U_3O_8 51·45, ThO_2 nil, Pb 2·31, SiO_2 2·75, Al_2O_3

1·12, Fe_2O_3 41·51. Mn present, MgO trace, CaO 1·01, S 0·14, CO 0·42 = 100·71. The Pb-U ratio indicates an age of 387 million years. L. J. S.

VANDENDRIESSCHE (A.). *De pekblende van de nieuwe uranium vindplaats te Kalongwe.* Natuurwetenschappelijk Tijdschrift, Ghent, 1935, vol. 17, pp. 197–203 (Flemish with English summary), 2 figs.

Pitchblende from the new locality Kalongwe in Katanga [M.A. **5**-292, 389] is intergrown with chalcosine and chalcopyrite. It is much weathered and is soluble in HCl; sp. gr. 5·8, H. 3–4. Analysis gave U_3O_8 75·80, PbO 7·38, $Al_2O_3 + Fe_2O_3$ 1·19, CaO 1·31, Cu 1·67, SiO 2·12, H_2O+ 5·56, H_2O- 1·67. The Pb/(U + 0·36 Th) ratio 0·100 corresponds with an age of 752 million years. L. J. S.

[LABUNTZOV (A. N.)] Лабунцов (А. Н.). О возрасте уранинита и монацита из пегматитовых жил северной Карелии. LABUNCOV (A. N.). *Über das Alter von Uraninit und Monazit aus den Pegmatitgängen Nordkareliens.* Докл. Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1935, vol. 1, pp. 646–647 (Russian), pp. 647–648 (German).

From the analysis of uraninite by K. A. Nenadkevich [M.A. **3**-263] and monazite by I. D. Starynkevich, both from pegmatite veins in north Karelia, the age of uraninite is determined as 2125 million years (RaG : U = 0·296) and the age of monazite as 2114 million years (ThD : Th = 0·0798) S. I. T.

IIMORI (Satoyasu), YOSHIMURA (Jun), & HATA (Shin). *Radioactive minerals from Shinden, Gifu prefecture.* Sci. Papers Inst. Physical & Chem. Research, Tokyo, 1934, vol. 20, no. 485, pp. 209–211, 1 fig.

Allanite, a black prismatic crystal with brown streak, gave SiO_2 31·04, ThO_2 1·55, Ce earths 22·69, Yt earths 1·96, Al_2O_3 12·93, Fe_2O_3 2·94, FeO 13·38, MnO 0·82, MgO 0·16, CaO 9·35, H_2O 2·42 = 99·24, sp. gr. 3·70–3·96. Gadolinite, a black prismatic crystal with pale greenish streak, gave SiO_2 23·59, ThO_2 1·78, Ce earths 16·80, Y earths 33·62, U_3O_8 0·49, BeO 9·65, Al_2O_3 trace, Fe_2O_3 0·70, FeO 11·50, MnO 0·31, MgO trace, CaO 0·86, H_2O 0·79 = 100·09; sp. gr. 4·33. The pale bluish microcline-perthite in which those minerals are embedded shows a brilliant thermoluminescence. L. J. S.

KIMURA (Kenjirō) & IIMORI (Takẹo). *Chemical analyses of monazite, uraninite, and autunite from Japan.* (Japanese.) Journ. Geol. Soc. Tokyo, 1936, vol. 43, pp. 450–452.

Monazite from Kotôge, Fukuoka prefecture, gave P_2O_5 26·41, SiO_2 3·07, UO_3 0·44, ThO_2 5·53, Ce_2O_3 22·03, rare-earths 38·57, Fe_2O_3 1·52, BeO 1·44, ign. loss 1·38 = 100·39; Ra $1·39 \times 10^{-9}$ gram per gram of mineral. Uraninite from the same locality gave U_3O_8 89·34, ThO_2 1·89, rare-earths 3·12, PbO 1·12, $Fe_2O_3 + Al_2O_3$ 0·25, residue 4·10 = 99·82; Ra $2·55 \times 10^{-7}$ g.; the lead ratio gives an age of 102 million years. Uraninite as cubic crystals from Masaki, 5 km. north of Kotôge, gave U_3O_8 89·34, ThO_2 2·07, rare-earths 6·44, PbO + residue 1·79 = 99·64; age 96 million years. Autunite from Yamaguchi prefecture gave P_2O_5 12·9, SiO_2 4·5, UO_3 51·4, Al_2O_3 5·9, Fe_2O_3 1·0, CaO 5·9, H_2O+ 6·4, H_2O- 12·6 = 100·6; Ra $9·58 \times 10^{-9}$ g.

R. O.

SPENCE (Hugh S.) & MUENCH (O. B.). *Monazite from West Portland township, Quebec.* Amer. Min., 1935, vol. 20, pp. 724–732.

Rough crystals and cleavage masses (up to ¾ lb.) of dark reddish monazite occur with euxenite, tourmaline, tengerite, &c., in pegmatite in a felspar quarry. Determinations by the method of C. N. Fenner [M.A. **4**–114] gave Th 3·44, Pb 0·068, U 0·054 %, corresponding to an age of 391 million years. A micro-chemical analysis of the mineral is given.

L. J. S.

MUENCH (O. B.). *Sulfur in cyrtolite and its indication of galena.* Amer. Min., 1936, vol. 21, pp. 374–378.

The amount of sulphur in cyrtolite from Bedford, New York, is estimated as 0·029 and 0·030 % in two samples, and in cyrtolite from Hybla, Ontario, 0·005 %, which is not enough for all the lead (Pb 0·374 and 0·035 from Bedford, and 0·043 % from Hybla) to be present as sulphides. Cyrtolite from Henvey, Ontario, contains S 0·079 % (Pb 0·036 %). From the Pb/U ratio the age of the Bedford mineral is 400, Hybla 600, and Henvey 140 million years.

L. J. S.

MARBLE (John Putnam). *Possible age of monazite from Mars Hill, North Carolina.* Amer. Min., 1936, vol. 21, pp. 456–457, 1 fig.

Monazite from this locality [M.A. **5**–519] contains: Pb 0·152, 0·175; Th 5·526, 5·596, U 0·019, 0·016 %. The age is approximately 584 million years.

L. J. S.

Marble (John Putnam). *Age of allanite from Amherst County, Virginia, U.S.A.* Amer. Journ. Sci., 1935, ser. 5, vol. 30, pp. 349–352.

Allanite from hypersthene-granodiorite, presumably of pre-Cambrian age, gave Pb 0·059, Th 1·250, U 0·083 %, indicating an age of 800 million years. L. J. S.

Evans (Robley D.). *Apparatus for the determination of minute quantities of radium, radon and thoron in solids, liquids and gases.* Rev. Sci. Instruments (Amer. Inst. Physics), 1935, n. ser., vol. 6, pp. 99–112, 8 figs.

Improved apparatus is described for measuring the radium content of rocks, sea-water, and various organisms. The radon produced in equilibrium with the radium is removed by boiling the sample at 2000° C. in a special direct-fusion furnace. Results are given for intrusive igneous rocks, sedimentary rocks, and sea sediments. The radium content of rocks is of the order of 10^{-12} gram Ra per gram and in general increases with increasing silica content; there is evidence to show, however, that the radium of rocks may be more closely correlated with potassium than with silica. F. A. B.

Evans (Robley D.) & Williams (Howel). *The radium content of lavas from Lassen volcanic national park.* Amer. Journ. Sci., 1935, ser. 5, vol. 29, pp. 441–452, 1 fig.

The radium content ($\times 10^{-12}$ gram per gram of rock) was determined for different types of rocks from this area in California: basalt, Ra 0·33, SiO_2 51·13 %; basic inclusions, Ra 0·34, SiO_2 55·14; andesite, Ra 0·48, SiO_2 60·72; dacite, Ra 0·80, SiO_2 66·65. The residual glass is richest in radium, while the felspar and biotite contain much less. There seems to be no connexion between the amount of radium and the age of the flows. L. J. S.

Holmes (Arthur) & Paneth (F. A.). *Helium-ratios of rocks and minerals from the diamond pipes of South Africa.* Proc. Roy. Soc. London, Ser. A, 1936, vol. 154, pp. 385–413, 3 figs.

Determinations of the amounts of helium, uranium, and thorium in kimberlite and included rocks and minerals (garnet, chrome-diopside, and zircon) gave variable results. The kimberlite contains He $30·5 \times 10^{-6}$ c.c. per gram of rock, and from the He/(U + 0·27 Th) ratio its age is deduced as 58 million years, corresponding with the late Cretaceous period. Included rocks of the amphibolite group

(appinite) and the eclogite nodules are older (probably pre-Cambrian), while those of the peridotite suite gave lower values. L. J. S.

Soloviev (S. P.). *The granodiorite laccolith of the Malka river (north Caucasus) and its content of radium.* Amer. Journ. Sci., 1936, ser. 5, vol. 32, pp. 380–391, 3 figs.

This laccolith of Palaeozoic age is intruded into schists. The mean of 52 determinations of Ra is $1{\cdot}89 \times 10^{-12}$ gram per gram of rock. The upper portion of the mass contains more Ra than the lower portion. A granodiorite of pre-Cambrian age from the Irik river, Mt. Elbruz, Persia, contains $1{\cdot}3 \times 10^{-12}$ and $0{\cdot}37 \times 10^{-12}$. L. J. S.

Kurbatov (L. M.). *On the radioactivity of bottom deposits. I. Some determinations of the radioactivity of ferromanganese formations in seas and lakes of U.S.S.R.* Amer. Journ. Sci., 1937, ser. 5, vol. 33, pp. 147–153.

Iron-manganese concretions contain on an average $10{\cdot}9 \times 10^{-10}$ % Ra. L. J. S.

Zeolites

[illegible]ey (Max H.). *The nature and relations of the zeolites: a review.* Trans. Ceramic Soc. Stoke-on-Trent, 1937, vol. 36, pp. 84–97, 3 figs.

A review of the structure, dehydration, and base-exchange of the zeolites [Min. Mag. **22–24**; M.A. **1–6**], and comparing these with clays. The following definition is given of the zeolites. 'A group of crystalline solids, hydrated aluminosilicates of mono- and divalent bases, in which the ratio $(R'',R'_2)O : Al_2O_3$ is unity, which are capable of losing a part or the whole of their water without change of crystal structure, and of absorbing other compounds in place of the water removed, and which are capable of undergoing base-exchange.'

L. J. S.

[illegible]ey (Max H.). *Diffusion in zeolitic solids.* Phil. Mag., 1936, ser. 7, vol. 22, pp. 492–497.

The author's kinetic theory [Min. Mag. **24**–124] of diffusion in zeolitic solids agrees well with the experimental data of Tiselius for the system analcime-ammonia and of Jost and Widmann for the palladium-hydrogen system. It is shown that if the sets of diffusion channels within a zeolitic solid possessing cubic symmetry are

independent (as in analcime) the diffusion constant is independent o direction and is one-third the value for diffusion along any one se of channels. [M.A. **6**–126.] F. A. B.

TISELIUS (Arne). *Adsorption and diffusion in zeolite crystals.* Journ Physical Chem., 1935, vol. 40, pp. 223–232, 9 figs.

For the most part a general discussion and review of previou work [M.A. **6**–126], but there are several new observations. Evidenc that the water or other volatile component in zeolites is probabl co-ordinated with the cations is found in the colour of copper-chaba zite and copper-chabazite-ammonia, which are similar to those c hydrated copper salts and of cuprammonium salts respectively.

M. H. H.

TISELIUS (Arne). *Sorption und Diffusion von Ammoniak in Analcim* Zeits. Physikal. Chem., 1935, Abt. A, vol. 174, pp. 401–42 5 figs.

Analcime from the Faeroe Is. (SiO_2 56·42, Al_2O_3 22·21, Na_2O 13·0 CaO and K_2O traces, H_2O 8·67 = 100·32), after dehydration, took u 124 c.c. NH_3 per gram, measured at N.T.P., or very nearly 1 mol. pe mol. H_2O. The dissociation pressures of the ammonia were measure at various temperatures and ammonia contents. The heat of reactio is $1{\cdot}66 \times 10^4$ cals. per gram-mol. NH_3, and is independent of the am monia content. The sorption volume per molecule is $1{\cdot}08 \times 10^{-2}$ Å at 302° C., 1·16 at 341·3°, and 1·29 at 385°, and decreases slightl with increase in ammonia content; this volume is evidently th volume available for movement of an ammonia molecule about it equilibrium position. An equation connecting the sorption volum with the vibration frequency of the ammonia molecules leads to figure of $1{\cdot}6 \times 10^{13}$ per second, which is about the expected value the ammonia molecules occupy definite lattice positions, but not they move freely through the lattice. The rate of diffusion ammonia in analcime was also studied, and evidence obtained tha the diffusion constant does not vary appreciably with the ammoni content. The constant is $1{\cdot}2 \times 10^{-8}$ cm.^{2}/sec. normal to (100) a 302° C. and $1{\cdot}3 \times 10^{-8}$ normal to (110); its temperature coefficien indicates an activation energy of diffusion about $1{\cdot}148 \times 10^4$ cal per gram-mol. NH_3. The birefringence of analcime is 0·0003 increasing on complete dehydration to 0·00221, and decreasin again on absorption of ammonia. M. H. H.

Damerell (V. R.) & Cadle (R.). *The surface behavior of zeolites.* Journ. Physical Chem., 1935, vol. 39, pp. 693–694.

Scolecite and analcime, ground to two different degrees of fineness, were exposed to atmospheres of several different degrees of humidity and temperatures and the equilibrium water contents determined. It is concluded that, when fully saturated but without any surface adsorption, scolecite contains 15·50 % and analcime 9·39 % of water [calc. on the anhydrous salt]. The scolecite is believed to lose no water from within the lattice even over BaO at 126° C., while the analcime undergoes surface dehydration when exposed over P_2O_5 at room-temperature. M. H. H.

Sameshima (Jitsusaburo) & Morita (Noriyoshi). *Sorption of gas by mineral. V, VI.* Bull. Chem. Soc. Japan, 1935, vol. 10, pp. 485–490, 490–494.

The absorption of carbon dioxide and of ammonia by dehydrated mordenite, thomsonite, scolecite, epistilbite, phillipsite, sepiolite, talc, serpentine, asbestos, vivianite, bentonite, and Japanese acid clay, all from named localities, have been studied. Talc, serpentine, and vivianite have no absorptive power; acid clay, asbestos, and bentonite absorb ammonia but not carbon dioxide, as also do thomsonite, scolecite, epistilbite, and phillipsite. Mordenite and sepiolite absorb both ammonia and carbon dioxide. The zeolites, except mordenite, are regarded as combining chemically with ammonia, while mordenite is considered to absorb the gases in its pores (sponge theory). Sepiolite resembles silica gel in its absorption behaviour. M. H. H.

Lamb (Arthur B.) & Ohl (Edwin N.). *Heats of adsorption of gases and vapours upon crystallogenetic adsorbents.* Journ. Amer. Chem. Soc., 1935, vol. 57, pp. 2154–2161, 6 figs.

The heats of absorption of a number of gases by dehydrated chabazite, thomsonite, and brucite (unanalysed material) at 0° C. have been measured directly; the heats vary only slightly with the amount of vapour absorbed, but diminish distinctly as the degree of dehydration of the mineral is reduced. Certain regularities in the heats of absorption are discussed. M. H. H.

Sekanina (J.) & Wyart (J.). *Sur la stilbite.* Bull. Soc. Franç. Min., 1936, vol. 59, pp. 377–383, 4 figs.

The unit cell of stilbite has the dimensions a 13·60, b 18·13, c 11·29 Å., all $\pm\frac{1}{2}$ %, β 52° $\pm\frac{1}{2}$°. Goniometer measurements gave

β 51° 51′ to 52° 31′. The space-group, assuming holohedry, is C^3_{2h}, and the repeat near $Na_2Ca_4Al_{10}Si_{26}O_{72}.28H_2O$. There is usually some deficit of Na from the above formula; Ca may be in excess or deficit; Si is always in deficit, but the variations are never great. The structure is very similar to that of heulandite. M. H. H.

Winchell (A. N.). *Further studies of the zeolites.* Amer. Min., 1937, vol. 22, pp. 85–96, 9 figs. Abstract, Ibid., p. 206. [Cf. M.A. **3**–13.]

Many analyses of zeolites are plotted to show the variations in composition in each species. The square diagram previously used is somewhat modified; and a triangular diagram has $Si_4O_8.Aq$, $CaAl_2Si_2O_8.Aq$, and $Na_2Al_2Si_2O_8.Aq$ at the three corners. The optical data of thomsonite are plotted against the composition.

L. J. S.

Thugutt (Stanisław Józef). *O produktach hydrolizy natrolitu.—Sur les produits hydrolytiques de la natrolite.* Arch. Min. Tow. Nauk. Warszaw. (Arch. Min. Soc. Sci. Varsovie), 1935, vol. 11, pp. 134–138 (Polish), pp. 139–140 (French résumé).

Natrolite from Hohentwiel, Baden (sp. gr. 2·23, anal. I), was heated with pure water for 100 hours at 221–240° C. Nearly 50% went into colloidal solution (anal. II); the insoluble residue gave III. The separated liquid after standing for 36 days gave IV, after yielding a sediment (anal. V).

	SiO_2.	Al_2O_3.	Fe_2O_3.	MnO.	Na_2O.	K_2O.	H_2O.	Total.
I.	47·53	26·31	0·91	0·06	14·45	0·49	10·73	100·48
II.	37·97	26·19		—	16·70	—	19·14	100·00
III.	51·52	25·09	0·69	—	13·67	—	9·03	100·00
IV.	34·86	26·06	1·23	—	18·78	—	19·07	100·00
V.	50·43	24·83		—	15·47	—	9·27	100·00

L. J. S.

Nováček (Radim). *Dva zajímavé výskyty zeolitů.* [Two interesting occurrences of zeolites.] Časopis Národního Musea, Praha, 1936, vol. 110, pp. 49–54, 2 figs.

At Vrahožily (= Frauschile), near Teplice, veins in phonolite are filled with compact yellowish-brown natrolite, together with coarse-grained calcite and columnar aggregates and acute-domatic crystals of aragonite. The natrolite consists of minute (0·1 – 0·2 mm.) spherulites; analysis gave SiO_2 46·60, TiO_2 0·15, Al_2O_3 27·21, Fe_2O_3 0·52, FeO 0·06, MgO 0·05, CaO trace, Na_2O 14·80, K_2O 0·31, H_2O

10·24 = 99·94, sp. gr. 2·146. Trials for iron ore at Železná Ruda (= Eisenstein), near the border of Bohemia and Bavaria, reached in the foot-wall of a layer of crystalline chalybite an albitized and chloritized gneiss impregnated with pyrite. Small veins in this gneiss contain spheroidal aggregates of stilbite which has α 1·497, γ 1·506, sp. gr. 2·144; analysis gave SiO_2 55·81, Al_2O_3 16·58, Fe_2O_3 0·58, FeO 0·18, MnO trace, MgO trace, CaO 7·86, Na_2O 0·91, K_2O 0·36, H_2O 17·96 = 100·24. Associated minerals are quartz, albite, heulandite, and epidote. F. S.

Kratochvíl (František). *Mineralogické poznámky.* [Mineralogical notes.] Věda Přírodní, Praha, 1936, vol. 17, pp. 226–227.

The following optical determinations were made on zeolites from cavities in amphibolites near Čáslav, eastern Bohemia. Laumontite from Markovice, α 1·510, γ 1·520, sp. gr. 2·281. Heulandite from Hejdov, α 1·495, β 1·498, 2V 59°. Analcime from Hejdov, n 1·487, sp. gr. 2·258. Natrolite from Markovice, α 1·473, β 1·476, γ 1·486, 2V 61°, $r < v$, sp. gr. 2·253. Prehnite from Mrač near Benešov, α 1·614, β 1·623, γ 1·643, 2V 68°, sp. gr. 2·883. Olivine in basic eruptive rocks from Hvožďany, near Poběžovice (= Ronsperg), west Bohemia, contains nickel in isomorphous admixture: e.g. a wehrlite rock contains NiO 0·11 %. F. S.

Tuček (Karel). *Nové nálezy zeolitů v podkrkonošských melafyrech.* [New zeolite finds in the melaphyres at the foot of the Giant Mts.] Věda Přírodní, Praha, 1936, vol. 17, pp. 231–233.

At Mt. Kozákov, near Turnov, north Bohemia, the well-known locality for jasper and agate, a newly opened vein is filled in succession with jasper, vein quartz (often amethyst), scalenohedra of calcite, heulandite (crystals *b t s c m*), and chabazite (phacolite); laumontite is very rare. Analcime has been found at two other localities—Levín, near Nová Paka; and Železnice, near Jičín. F. S.

Bloomer (Robert O.). *Occurrence of stilbite in the Border Conglomerate near Culpeper, Virginia.* Amer. Min., 1937, vol. 22, pp. 309–310, 1 fig.

This conglomerate forms the base of the Keuper, which is intruded by diabase dikes. Stilbite in small amount, together with calcite, encrusts the pebbles and fills cavities. It is probably of secondary origin due to hydrothermal solutions. It has α 1·489, β 1·498, γ 1·499, 2V 30° ± 5°. L. J. S.

Miscellaneous.

Henderson (E. P.) & Glass (Jewell J.). *Pyroxmangite, new locality: identity of sobralite and pyroxmangite.* Amer. Min., 1936, vol. 21, pp. 273–294, 3 figs.

Cleavage masses of a pink mineral covered and penetrated by dark brown stains, from Idaho, are triclinic with cleavages m (110), M ($1\bar{1}0$), b (010), c (001), a (100). Analysis I, (Mn,Fe)SiO_3; α 1·737, β 1·740, γ 1·754, 2V 39°, positive. It is identified with pyroxmangite (of Ford and Bradley, 1913) from South Carolina and with sobralite (of J. Palmgren, 1917) from Sweden, for which new data are given. The mineral shows many points of resemblance to rhodonite, with nearly the same cleavage angles and X-ray pattern; but there is a difference in the optical data, suggesting a gap in the series (Mn,Fe)SiO_3. Rhodonite from Bald Knob, North Carolina, gave anal. II, α 1·724, β 1·728, γ 1·737, 2V 70°; and an iron-rich rhodonite from Broken Hill, New South Wales, gave III, α 1·726, β 1·730, γ 1·739, 2V 74°.

	SiO_2.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	H_2O.	Total.	Sp. gr.
I.	45·47	1·50	20·91	27·06	2·14	2·62	0·32	100·02	3·66
II.	45·17	0·93	2·44	45·98	1·31	4·10	0·30	100·23	3·75
III.	46·45	0·12	12·65	35·10	0·40	5·45	0·27	100·44	3·68

L. J. S.

Schwarz (M. v.). *Gefügeausbildung der terrestrischen Eiseneinschlüsse im Basalt vom Bühl bei Kassel.* Zentr. Min., Abt. A, 1937, pp. 74–91, 16 figs.

The native iron in the basalt of Bühl contains 0·14–0·33 % C, and no P, Ni, Co. It consists of grains of ferrite bordered by magnetite and pyrrhotine, and with adjoining or isolated patches of pearlite. The pearlite is sometimes altered to 'oxide-pearlite', due to the oxidation of the cementite lamellae to iron oxide. The iron was formed by the reduction of iron compounds by C or CO; and it has since been broken by mechanical movements and in part altered to magnetite and afterwards to pyrrhotine. [Cf. M.A. **6**–191.] L. J. S.

Tilley (C. E.). *Pyroxmangite from Inverness-shire, Scotland.* Amer. Min., 1937, vol. 22, pp. 720–727, 3 figs.

Pink grains in grunerite-garnet-schist in the para-gneisses at Glen Beag, Glenelg, show prominent cleavages m and M, and have α 1·732, β 1·735, γ 1·750, 2V 41°, positive, sp. gr. 3·63; analysis by H. Bennett gave SiO_2 47·44, Al_2O_3 0·66, Fe_2O_3 1·45, FeO 15·02, MnO 28·25,

MgO 4·56, CaO 3·00 = 100·38. There is a marked difference between the optical data for pyroxmangite (= sobralite) and iron-rhodonite. The anorthic minerals of the system $MnSiO_3$–$FeSiO_3$–$CaSiO_3$ include pyroxmangite, rhodonite (iron-rhodonite), bustamite, wollastonite (iron-wollastonite and mangan-wollastonite); analyses are plotted and their relations as solid solutions discussed [M.A. **4**–527, **5**–143]. The 'iron-rhodonite' from slag [M.A. **1**–164] is shown to be identical with pyroxmangite [Min. Mag. **24**–573]. L. J. S.

Siegl (W.). *Über Tarnowitzit und Plumbocalcit von Tsumeb (Südwestafrika)*. Mitt. Wien. Min. Gesell., 1936, no. 101, *in* Min. Petr. Mitt. (Tschermak), 1936, vol. 48, pp. 286–288.

Plumbocalcite, containing up to 26 % $PbCO_3$, consists of an orientated intergrowth of minute crystals of cerussite in calcite. Crystals of tarnowitzite [plumbo-aragonite] show a clear core with cloudy outer zones; the former contains 3·12 % $PbCO_3$ isomorphously replacing $CaCO_3$, with a 4·97, b 8·015, c 5·79 Å., α 1·5424, β 1·6945, γ 1·6994, sp. gr. 3·007, 3·025. Excess of lead in the outer zones is probably present as an orientated growth of cerussite. [M.A. **4**–383, 525.] Mention is made of a plumbodolomite from Kreuth, Carinthia. L. J. S.

Barić (Ljudevit). *Disthen (Cyanit) von Prilepec im Selečka-Gebirge*. Zeits. Krist., 1936, vol. 93, pp. 57–92, 16 figs.

Good crystals of kyanite are found with garnet and staurolite in muscovite-schist at Prilepec and several other places in the Selečka Mts., near Prilep in southern Serbia. Crystal-forms present are *a b c M m e Q* [Dana's letters]. In the four twin laws the twin-axes are ⊥ (100), [010], ⊥ [010] in (100), and ⊥ $(\bar{1}21)$. The optical orientation is determined. For colourless crystals α 1·7131, β 1·7219, γ 1·7285, 2V 82° 15′ (Na). Analysis of colourless and faint bluish crystals, gave SiO_2 37·03, TiO_2 0·43, Al_2O_3 62·21, Fe_2O_3 0·30, CaO 0·08, H_2O+ 0·03, H_2O- 0·21 = 100·29; sp. gr. 3·653. TiO_2 is present as enclosed rutile needles. L. J. S.

Palache (Charles). *Babingtonite and epidote from Westfield, Massachussetts*. Amer. Min., 1936, vol. 21, pp. 652–655, 1 fig.

Fine specimens of babingtonite, as large ($\frac{1}{2}$–$\frac{3}{4}$ inch) rough crystals, have recently been discovered at this locality in veins in diabase. Associated minerals are calcite, quartz, prehnite, datolite, &c. Analyses by F. A. Gonyer of: I, babingtonite; II, black epidote (sp.

gr. 3·49, α 1·751, β 1·784, γ 1·797, 2V 64°) rich in iron and closely simulating the babingtonite.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	Na_2O.	H_2O+.	Total.
I.	52·32	0·15	0·95	13·42	10·65	0·31	0·50	19·88	0·27	1·36	99·81
II.	36·52	nil	20·97	17·22	0·45	nil	nil	23·05	—	1·98	100·19

L. J. S.

Peacock (M. A.). *On roselite and the rule of highest pseudo-symmetry.* Amer. Min., 1936, vol. 21, pp. 589–603, 9 figs.

Crystals of roselite from Schneeberg, Saxony, are monoclinic (not triclinic) with $a : b : c = 0{\cdot}8780 : 1 : 0{\cdot}4398$, $\beta = 79° 7'$; cleavage (010), and frequent twinning on (100). The number of crystal-forms is thereby considerably reduced, but four new forms are noted. 'Roselite is another case in which the lattice with the highest pseudo-symmetry (pseudo-orthorhombic) is a multiple lattice of the proper crystal lattice. In all such cases the Rule of Highest Pseudo-Symmetry gives unsatisfactory morphological elements and abnormal form symbols.' The optical data and orientation are markedly different in pale pink and dark pink crystals. L. J. S.

Peacock (M. A.). *On the crystal form of sternbergite.* Amer. Min., 1936, vol. 21, pp. 103–108, 7 figs.

Measurements of crystals of sternbergite ($AgFe_2S_3$) from Jáchymov, Bohemia, gave new axial ratios $a : b : c = 0{\cdot}5913 : 1 : 0{\cdot}6250$, with nine crystal-forms, five of which are new. The twin-plane m (110) is not an observed form. The angles show some relation to those of cubanite ($CuFe_2S_3$). L. J. S.

Peacock (M. A.) & Yatsevitch (G. M.). *Cubanite from Sudbury, Ontario.* Amer. Min., 1936, vol. 21, pp. 55–62, 5 figs.

Thick crystals (up to 5 mm. across) of cubanite from the Frood mine showed fifteen crystal-forms, including new e (012), referred to the axes $a : b : c = 0{\cdot}5822 : 1 : 0{\cdot}5611$ of C. Hlawatsch (1910) for 'chalmersite' from Brazil. All the crystals are twinned on (110). No cleavage could be detected. H. $3\frac{1}{2}$, sp. gr. 4·101. The crystals are magnetic and highly susceptible only along the b-axis. Analysis: S 35·35, Fe 41·41, Cu 22·88, agrees with $CuFe_2S_3$. L. J. S.

Schoep (A.). *Over cuprosklodowkiet* [sic]. Natuurwetenschappelijk Tijdschrift, Gent, 1936, vol. 18, pp. 282–283.

The yellowish-green needles of cuprosklodowskite [M.A. **5**–389; **6**–149, 345] from Kalongwe and Kambove in Katanga are ortho-

rhombic with the optic axial plane perpendicular to the elongation. Pleochroism, yellow-green along the length and blue perpendicular thereto; n 1·66–1·68, birefringence lower than for sklodowskite.

L. J. S.

Schoep (A.). *Sur les associations à cuprosklodowskite du Katanga.* Bull. Soc. Belge Géol., 1936, vol. 46, pp. 298–305, 2 figs.

Polished sections of specimens from Kalongwe and Kambove show cuprosklodowskite in crevices and enclosed in globules of compact kasolite with associated vandenbrandeite. L. J. S.

Schoep (A.) & De Leenheer (L.). *Qu'est-ce que la gummite?* Bull. Soc. Belge Géol., 1937, vol. 46, pp. 309–316, 1 pl.

Analysis of a specimen of gummite (d 6·352, n 1·96) from Kambove shows a composition very close to that of curite, and the X-ray pattern is also similar. In this case the gummite is a colloidal form of curite. In other cases it may be a mixture of uranotile and other secondary uranium minerals pseudomorphous after uraninite.

L. J. S.

Leitmeier (H.) & Feigl (F.). *Einfache Verfahren zum Nachweis von Molybdän, Blei und Kobalt in Mineralien und Gesteinen.* Min. Petr. Mitt. (Tschermak), 1936, vol. 47, pp. 313–327.

The following are delicate colour reactions for detecting the presence of minute quantities. Calcium xanthate gives a reddish-violet colour with molybdenum compounds. An acetic acid solution of benzidine gives a deep blue with lead oxide (in the absence of Mn). Alkali thiocyanates form double salts with cobalt (even in the presence of much Fe and Ni) which are soluble in a mixture of ether and ethyl alcohol giving a blue colour. L. J. S.

Miller (Christina C.) & Traves (Florence). *The determination of sodium and potassium in insoluble silicates.* Journ. Chem. Soc. London, 1936, pp. 1390–1394.

—— —— *A new method for the quantitative separation of lithium, with reference to its determination in insoluble silicates.* Ibid., pp. 1395–1399.

After decomposition of the silicate by the Lawrence Smith method, sodium is weighed as Na-Zn-UO_2 acetate and potassium as perchlorate [Min. Mag. **23**–409]. Lithium is extracted from the alkali chlorides by *iso*-amyl acetate or acetone, and weighed as Li-Zn-UO_2 acetate.

L. J. S.

Brewer (F. M.) & Baker (Enid). *Arc spectrographic determinatio of indium in minerals, and the association of indium with tin an silver.* Journ. Chem. Soc. London, 1936, pp. 1286–1290.

—— —— *The extraction of indium from cylindrite, chalcopyrite, an metallic tin.* Ibid., pp. 1290–1294.

Various tin, antimony, silver, and zinc minerals were examine for indium. The largest amounts were found in cylindrite fro Santa Cruz mine, Poopó, Bolivia (In 0·1–1 %), and in chalcopyrit from New Cook's Kitchen mine, Camborne, Cornwall (0·1 % Analyses of cylindrite gave S 24·39 (23·75), Sb 11·92 (7·74), Sn 25·0 (21·44), Pb 33·97 (38·65), Fe 3·47 (–) %, [totals 98·81 (91·58)]. ' therefore seems that there are two substances described as cylindrite Small amounts of indium were separated from the Fe-Zn precipitate from these minerals. L. J. S.

Winchell (A. N.). *A third study of chlorite.* Amer. Min., 193 vol. 21, pp. 642–651, 4 figs. [Cf. M.A. **3**–373, **4**–206.]

Forty chemical analyses with the corresponding optical data a plotted on a square diagram with the molecules $2H_4Mg_3Si_2O_9$ (ant gorite), $2H_4Fe_3Si_2O_9$ (ferroantigorite), $3H_4Mg_2Al_2SiO_9$ (amesite), an $3H_4Fe_2Al_2SiO_9$ (daphnite) at the four corners. The several varieti of chlorite to which special names have been applied fall into mo or less well-defined areas. A triangular diagram shows the effe of heating chlorites with oxidation of the ferrous iron and increas in the refractive indices. L. J. S.

Merriam (Richard) & Laudermilk (J. D.). *Two diopsides fro southern California.* Amer. Min., 1936, vol. 21, pp. 715–71 1 fig.

Snow-white, fine-grained diopside in metamorphic rocks fro Cascade Canyon, San Bernardino Co., has α 1·663, β 1·671, γ 1·693 analysis I. Pale green crystals in metamorphic limestone fro Crestmore, Riverside Co., have α 1·666, β 1·675, γ 1·695, 2V 59 $\gamma : c = 39° 10'$; anal. II (deducting some calcite). The former the purest native diopside yet analysed. Spectrographic analys shows traces of several other elements.

	SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MgO.	CaO.	H_2O+.	H_2O-.	Tota
I.	56·50	0·12	0·24	—	17·80	25·56	0·58	0·22	101·(
II.	54·54	1·28	0·93	0·30	17·23	24·76	0·64	0·32	100·(

L. J. S.

Butterfield (J. A.). *An occurrence of anatase (var. octahedrite) in the Millstone Grit of Yorkshire.* Trans. Leeds Geol. Soc., 1936, vol. 5, pt. 3 (for 1934–35), pp. 142–152, 6 figs.

Heavy minerals separated from the grit near Hebden Bridge include minute pyramidal crystals of anatase, usually of a blue colour, but sometimes yellow or particoloured. Associated minerals are brookite, rutile, ilmenite, &c. Hitherto only yellow tabular crystals of anatase have been recorded from the Millstone Grit.

L. J. S.

Pabst (Adolf). *Vesuvianite from Georgetown, California.* Amer. Min., 1936, vol. 21, pp. 1–10, 3 figs. Correction, p. 213.

Veins in serpentine contain idocrase, garnet, diopside, clinochlore, prehnite, tremolite, and opal. The idocrase forms white to yellow-green granular masses with crystal-lined vughs. The crystals are colourless, pale to dark green, or violet in colour and of long-prismatic habit rich in forms; $a:c = 1:0{\cdot}5376$. Pale crystals have ω 1·710, ϵ 1·707, and green crystals ω 1·7129, ϵ 1·7103. Analyses by W. H. Herdsman of I, green crystals d 3·326; and II, white vein material d 3·322. Spectroscopic tests show also the presence of manganese, boron, and vanadium. Small colourless crystals of grossular gave analysis III, d 3·506, n 1·737.

	SiO_2.	TiO_2.	Al_2O_3.	Cr_2O_3.	Fe_2O_3.	FeO.	MgO.	CaO.	H_2O.	Total.
I.	36·60	trace	19·75	0·18	0·80	1·64	2·58	37·80	0·60	99·95
II.	37·70	trace	19·30	nil	0·85	0·37	2·45	38·30	0·80	99·77
III.	39·30	nil	21·93	0·13	0·80	0·28	trace	37·10	0·30	99·84

L. J. S.

Foshag (William F.). *Ganophyllite and zincian amphibole from Franklin Furnace, New Jersey.* Amer. Min., 1936, vol. 21, pp. 63–67.

Ganophyllite as small acicular crystals has been previously recorded from this locality [M.A. **3**-216]. It is now found as large, clear brown cleavage plates, which are very brittle; H. 3½, sp. gr. 2·878; α 1·545, β 1·586, γ 1·589, acute bisectrix normal to the micaceous cleavage, optically negative. Analysis, SiO_2 44·36, Al_2O_3 11·40, FeO 0·09, MnO 24·24, MgO 3·82, CaO 2·64, Na_2O 2·86, K_2O 0·26, H_2O 10·72 = 100·39, gives a formula, $5MnO.Al_2O_3.7SiO_2.5H_2O$, slightly different from that of the original ganophyllite from Sweden. Associated with it is a soda-amphibole containing zinc; this is dark greenish-black with pleochroism α olive-green, β dark sage-green,

γ dark olive-green; α 1·665, β 1·673, γ 1·676; $a:c = 28°$, $\gamma = b$ negative. Analysis gave SiO_2 53·20, TiO_2 0·12, Al_2O_3 5·37, Fe_2O_3 8·03, FeO 4·46, MnO 2·97, ZnO 4·70, MgO 11·12, CaO 3·36, Na_2O 4·35, K_2O 0·21, H_2O 1·79 = 99·68, and the formula is written as $(Na,Ca,Zn,Mn)_3(Mg,Fe'')_3(Al,Fe''')_2Si_8O_{22}(O,OH)_2$. L. J. S.

Fleischer (Michael). *The formula of aenigmatite.* Amer. Journ. Sci., 1936, ser. 5, vol. 32, pp. 343–348.

From published analyses the formula is deduced as $X_4Y_{13}(Si_2O_7)_6O_2$ where X = Na, Ca, K, and Y = Fe'', Fe''', Ti, Mg, Mn, Al. A special case is $Na_4Fe''_9Fe'''_2Ti_2(Si_2O_7)_6$. In rhönite part of the Si is replaced by Al, and Na by Ca (as in anorthite and albite). Chemically and crystallographically [M.A. **4**–108, 199; **5**–478] aenigmatite does not belong to the hornblende group. L. J. S.

Parascandola (A.). *Sulla non esistenza della karelinite come specie minerale.* [Riv. Fis. Mat. Sci. Nat. Napoli, 1932, vol. 7, p. 7. Abstract in Periodico Min. Roma, 1937, vol. 8, p. 77.

Karelinite of R. Hermann (1858) from Zavodinsky mine, Altai, Siberia, is a mixture of bismuthinite, bismuth, and bismite, with a trace of carbonate. L. J. S.

Kelley (Vincent C.). *Occurrence of claudetite in Imperial County, California.* Amer. Min., 1936, vol. 21, pp. 137–138.

Some further particulars are given of the occurrence of claudetite on the west side of the Colorado river (35 miles north of Yuma in Arizona) [M.A. **5**–520]. A vein in impure limestones and calcareous schists, intruded by Tertiary volcanic rocks, consists in the centre of powdery sulphur with patches of realgar. Outwards gypsum, kaolin and halloysite grade into the surrounding rock. Tourmaline, quartz and chlorite are also present. The claudetite fills fissures in the realgar. L. J. S.

Murdoch (Joseph) & Webb (Robert W.). *Bustamite from Inyo County, California.* Amer. Min., 1936, vol. 21, pp. 69–70.

Bright pink bustamite forms irregular patches in a silicate rock found as boulders in Saline valley. L. J. S.

Staples (Lloyd W.). *A simple microchemical test for silicon.* Amer. Min., 1936, vol. 21, pp. 379–383, 3 figs.

The mineral is heated with fluorite and H_2SO_4 in a platinum spoon resting in a charcoal block over which is a celluloid slide carrying

drop of dilute HNO_3. On the addition of NaCl, crystals of sodium fluosilicate (Na_2SiF_6) are formed in the drop. L. J. S.

Coats (Robert R.). *Aguilarite from Comstock lode, Virginia City, Nevada.* Amer. Min., 1936, vol. 21, pp. 532–534.

Polished sections of ores showed the presence of aguilarite. This is dark grey, sectile, and optically isotropic, with much the same characters as argentite, with which it is associated, but microchemical tests gave Ag, S, Se. L. J. S.

Buerger (M. J.). *The probable non-existence of arsenoferrite.* Amer. Min., 1936, vol. 21, pp. 70–71.

An X-ray powder photograph of the supposed arsenoferrite from Jáchymov, Bohemia [M.A. **5**–46], is identical with one of löllingite. The alleged isotropic character is explained by the finely granular state of the mineral. L. J. S.

Schwartz (G. M.). *Magnetite metacrysts.* Amer. Min., 1936, vol. 21, pp. 635–641, 7 figs.

Embedded crystals of magnetite in metamorphosed iron formations and chlorite-schists are described from several localities. L. J. S.

Greig (J. W.), Merwin (H. E.), & Posnjak (E.). *Separation planes in magnetite.* Amer. Min., 1936, vol. 21, pp. 504–510, 3 figs.

Magnetite, from Mineville, New York, and other localities, showing good parting parallel to the octahedron faces was examined and no indication of twinning was detected. Other separation planes are (331), (110), and (100). Silicates are often deposited along these separation planes, which are believed to be produced by differential pressure, as in the jointing of rocks. Polished sections of magnetite when heated at 950–1000° yield lamellae of haematite along the separation planes. L. J. S.

Howland (Arthur L.). *An occurrence of barite in the red beds of Colorado.* Amer. Min., 1936, vol. 21, pp. 584–588.

Veins of baryte occur in limestone near Hartsel. Analysis gave SO_3 33·71 BaO 64·05, CaO trace, SrO nil, CO_2 0·22, ign. 0·14 = 98·12, sp. gr. 4·45, α 1·635, β 1·637, γ 1·646. The material is believed to have been extracted by ground-water from the red beds of the Maroon (Permian) formation, rather than to have been deposited by rising magmatic waters. Analysis of the water of a nearby hot spring shows no barium. L. J. S.

Murdoch (Joseph). *Andalusite in pegmatite.* Amer. Min., 1936, vol. 21, pp. 68–69.

Small prisms of andalusite occur with felspar, quartz, tourmaline, fibrolite, &c., at the edge of a pegmatite dike in contact with serpentine at Winchester, California. L. J. S.

Müller (Karl). *Augit vom Vesuv.* Zentr. Min., Abt. A, 1936, pp. 116–122, 6 figs. [Cf. M.A. **6**–190.]

Further notes on twinned crystals, including triplets. Curvature and surface markings are described. Analysis by E. Narici gave SiO_2 45·81, TiO_2 1·77, Al_2O_3 6·60, Fe_2O_3 6·57, FeO 4·72, MnO 0·09, MgO 12·40, CaO 21·44, BaO trace, Na_2O 0·33, K_2O 0·42, H_2O+ 0·13, H_2O- 0·06 = 100·34. L. J. S.

Marshall (P.). *The mineral tuhualite.* Trans. Roy. Soc. New Zealand, 1936, vol. 66, pp. 330–336, 11 figs.

Small, dark blue to black crystals of tuhualite [M.A. **5**–295] in comendite from Mayor (= Tuhua) island, Bay of Plenty, are orthorhombic with $a:b:c = 0{\cdot}915:1:0{\cdot}512$, three distinct pinakoidal cleavages, frequent parallel growth, and twinned on (011). Pleochroism very strong, $\alpha = a$ palest pink, $\beta = b$ purple, $\gamma = c$ deep violet, α 1·601, γ 1·607, 2V 65–70°, negative. From analyses of the rock the composition of the mineral is calculated as SiO_2 75·36, Al_2O_3 9·33, Fe_2O_3 3·61, FeO 2·33, MnO 0·18, Na_2O 4·75, K_2O 4·06, &c. An undetermined, strongly pleochroic, greenish-yellow mineral is perhaps an alteration product of tuhualite. L. J. S.

Holmqvist (P. J.). *Über die sog. hohlen Kanäle in Kalkspat.* Arkiv Kemi, Min. Geol. Stockholm, 1936, vol. 12 A, no. 10, 16 pp., 4 pls., 10 text-figs.

A review is given of the literature on the so-called 'hollow canals' in deformed crystals of calcite. These represent the intersections of twin-lamellae on two planes of $-\frac{1}{2}R$ (110), and they are really fibres of opaque white material. The space they occupy is 17 % less than the original material, which has been crushed between the crossing lamellae. L. J. S.

Swartzlow (Carl R.) & Keller (W. D.). *Coralloidal opal.* Journ. Geol. Chicago, 1937, vol. 45, pp. 101–108, 4 figs.

Coralloidal and stalactitic growths of white to dark grey opal encrust the walls of tubes and caves in basaltic lava in the Lassen Volcanic National Park, California. The material has n 1·410–1·420 in a sample containing 11·53 % H_2O, n 1·413. L. J. S.

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Reprinted by lithography and bound in Great Britain